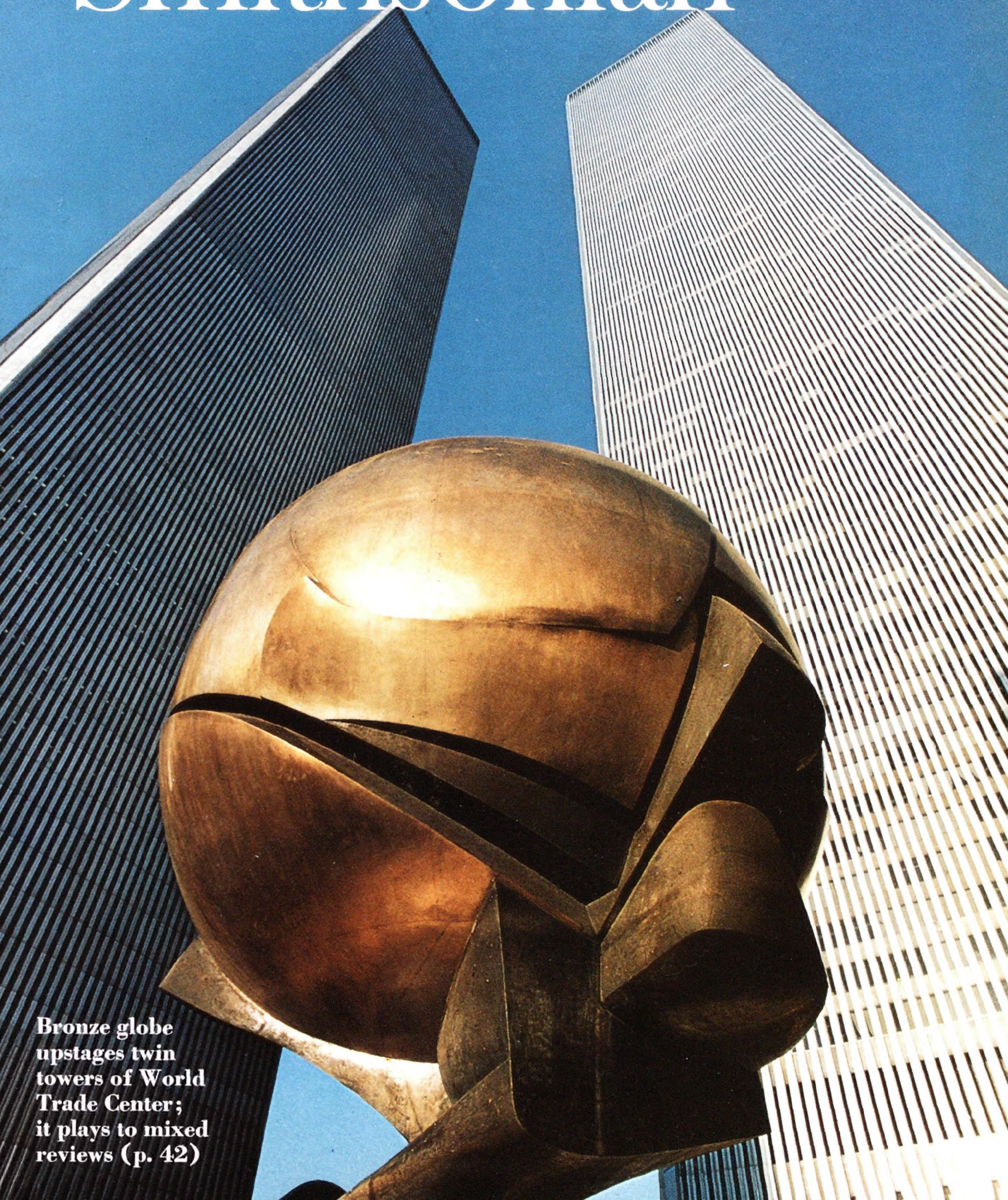
*January 1978*

# Smithsonian



**Bronze globe upstages twin towers of World Trade Center; it plays to mixed reviews (p. 42)**

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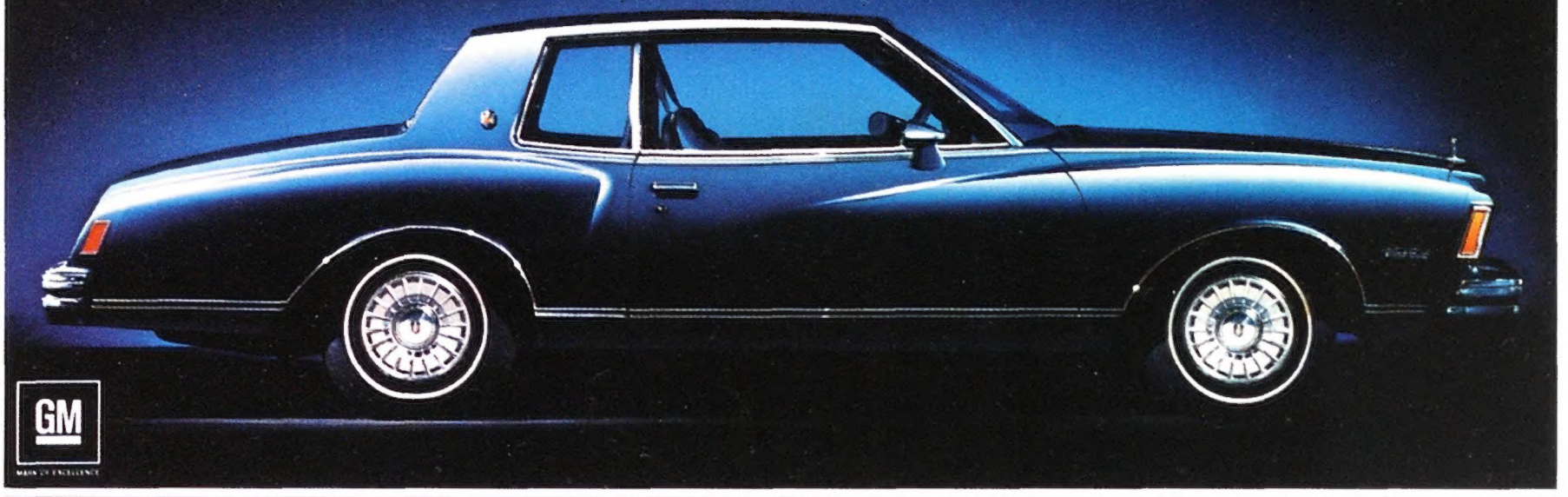


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|---|---|
| EPA* ESTIMATES HIGHWAY | 27 |
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Chevrolet

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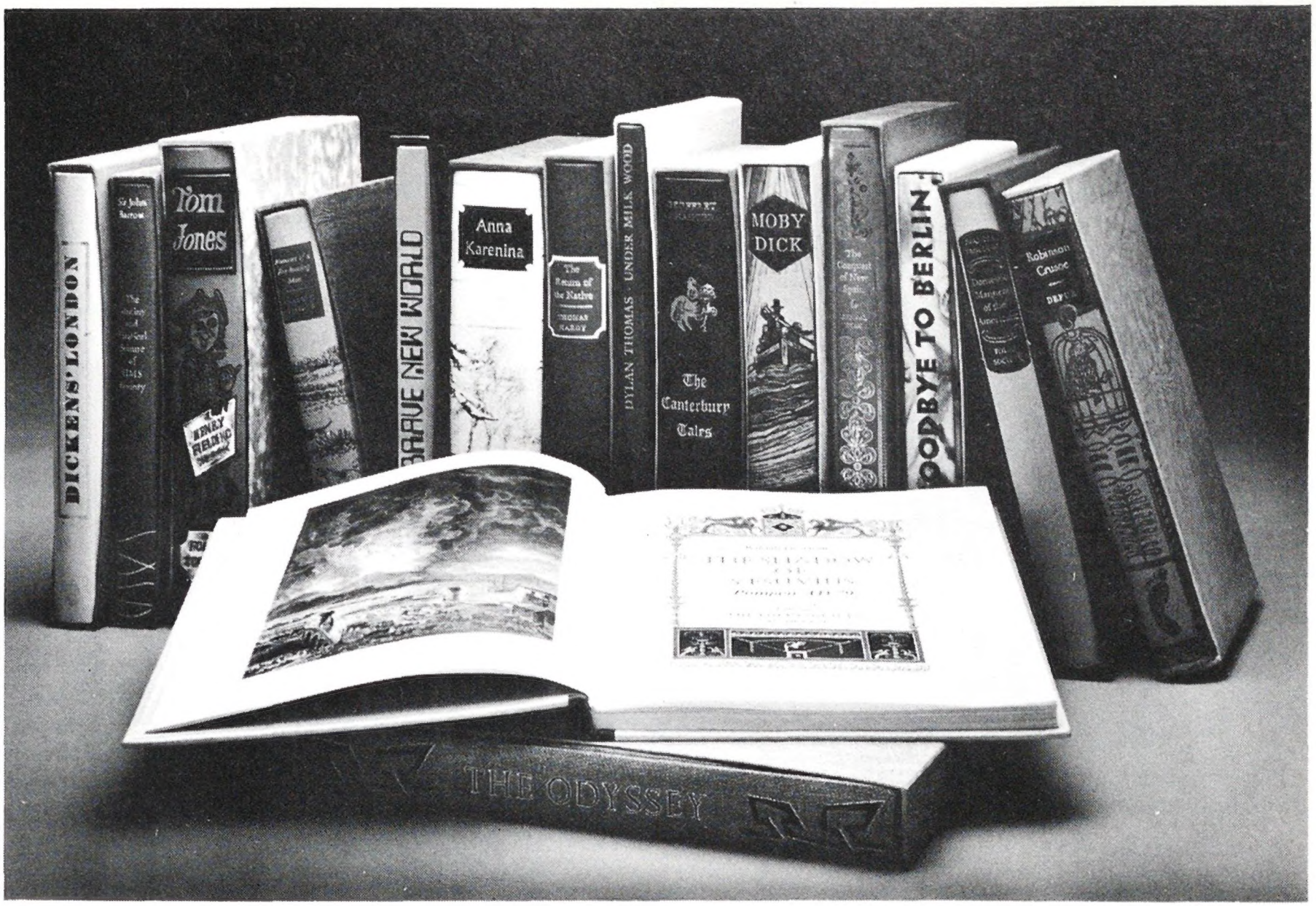


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68W

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*January 1978*

# Smithsonian

Volume 8, Number 10

## *Table of Contents*

COVER: A 17-ton globe by Fritz Koenig of Munich revolves in the plaza of Manhattan's World Trade Center (p. 42). Photograph by Marvin E. Newman

8 The view from the castle: Secretary Ripley's comments

14 Around the Mall and beyond by Edwards Park

16 Picture credits

20 Letters to the Editor

27 Phenomena, comment and notes by James K. Page jr.

32 The ice ages may return, but we expect to have a few thousand years to get ready for them
By Nigel Calder

42 Still controversial after seven years, New York City's World Trade Center is getting a lived-in feeling
By Russell Lynes, photographs by Marvin E. Newman

52 Pheena, the finback whale, is one of a kind: a ton of fiber glass and steel, 50 feet long, most instructive
By Matt Herron

62 What comes naturally to the artist Michael Singer is using nature's materials—out-of-doors
By Benjamin Forgey

70 A new window opens on the Renaissance: scholars rediscover Pope Clement XI's library in Washington
By Michael Olmert, photographs by Henry Groskinsky

78 Those mighty orchestralike fairground organs: a French collector has at least 50 of them
By Rudolph Chelminski, photographs by Pierre Boulat

84 Microscopes reveal more mysterious things than fish in the familiar ecosystems of self-contained ponds
By C. W. Hart jr., photographs by John Walsh

92 Hail to 14 forgotten Chiefs! They were Presidents of our country before George Washington
By Richard B. Morris

106 Book reviews

114 Additional reading

116 January events at the Smithsonian

118 Smithsonian tours

120 Some people prefer old age to the alternative
By Patrick Ryan

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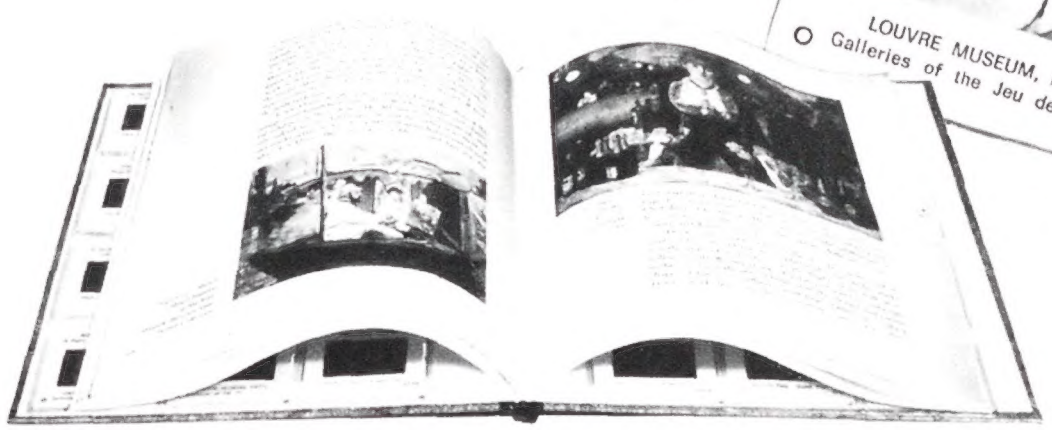

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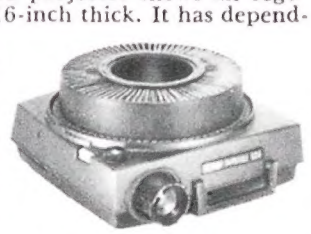

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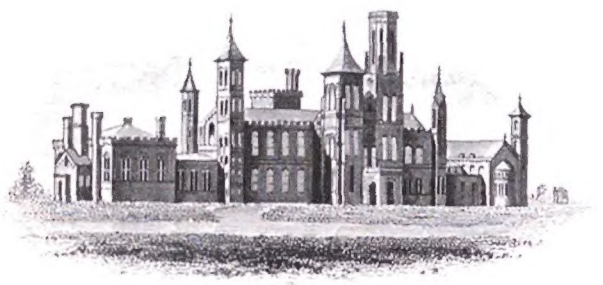
# *The view from the castle*



*At the Smithsonian we are more than ever convinced of the necessity for making practical application of basic research*

To work these days at the Smithsonian is an invigorating experience. In many ways we are discovering the practical applications of the things we do. I remember well my first glimpses of the Institution during World War II, when, under the direction of the famous anthropologist Julian H. Steward, we began a whole series of pamphlets for the military overseas—on everything from edible plants in the South Pacific islands to the cultural patterns of inhabitants of jungles and remote mountain ranges. I began such a pamphlet on the birds of the Southwest Pacific before I was swept up in the war myself.

Now we have a new sense of urgency about making use of the knowledge derived from our collections. We are proposing a massive study of whale strandings and of the movements of our friendly fellow mammals, inhabiters of the last great earthly frontier—the seas. The Smithsonian is one of the very few centers qualified for such work, as readers will recall (SMITHSONIAN, May 1977). We are planning to enlarge our study of runoffs of pesticides and agricultural fertilizer additives in Chesapeake Bay. For the first time we are correlating the die-offs of rooted aquatic vegetation with agricultural practices on land, and the eventual effect on Man and the larger mammals, fish and birds.

We are working in the field of amphipods, those minute crustaceans of the seashore such as side swimmers and scuds, which are extremely sensitive to the effects of oil pollution. Thus they may prove to be a potential early-warning system of value in monitoring the transport of oil by ship or pipeline. Also, the work of our Tropical Research Institute may bring new understanding of the high productivity of Panama Bay, an area of marked seasonal fluctuations in the availability of food fishes.

Many of these projects are by-products of basic research associated with our collections. How can we distinguish between basic and applied research? I maintain that we cannot, especially in the two areas of science where conceptualization is most difficult: biology and the study of Man himself. These are the sciences that elude simple tabulation and yet most of biology, for example, is based on exact knowledge derived from the observation of objects in nature. Without such knowledge, environmental-impact statements are worthless—charades, money thrown away.

In the same way, our knowledge of human cultures depends on an exact description of habits and patterns of behavior, especially in places where tribal cultures remain distinct. New techniques of analysis are giving anthropologists and cultural historians fresh insights into human behavior. In years to come, such knowledge may have its application in ensuring survival itself.

I and my colleagues at the Smithsonian have a new conviction that what we do is important, even vital, for our citizens. Through exhibits and open-education programs we can tell stories still unfolding, revealing patterns in the world around us of importance for our future. So come in, 1978! We welcome the new year as another step along the way toward truths revealed and knowledge yet to be made patent.

S. Dillon Ripley

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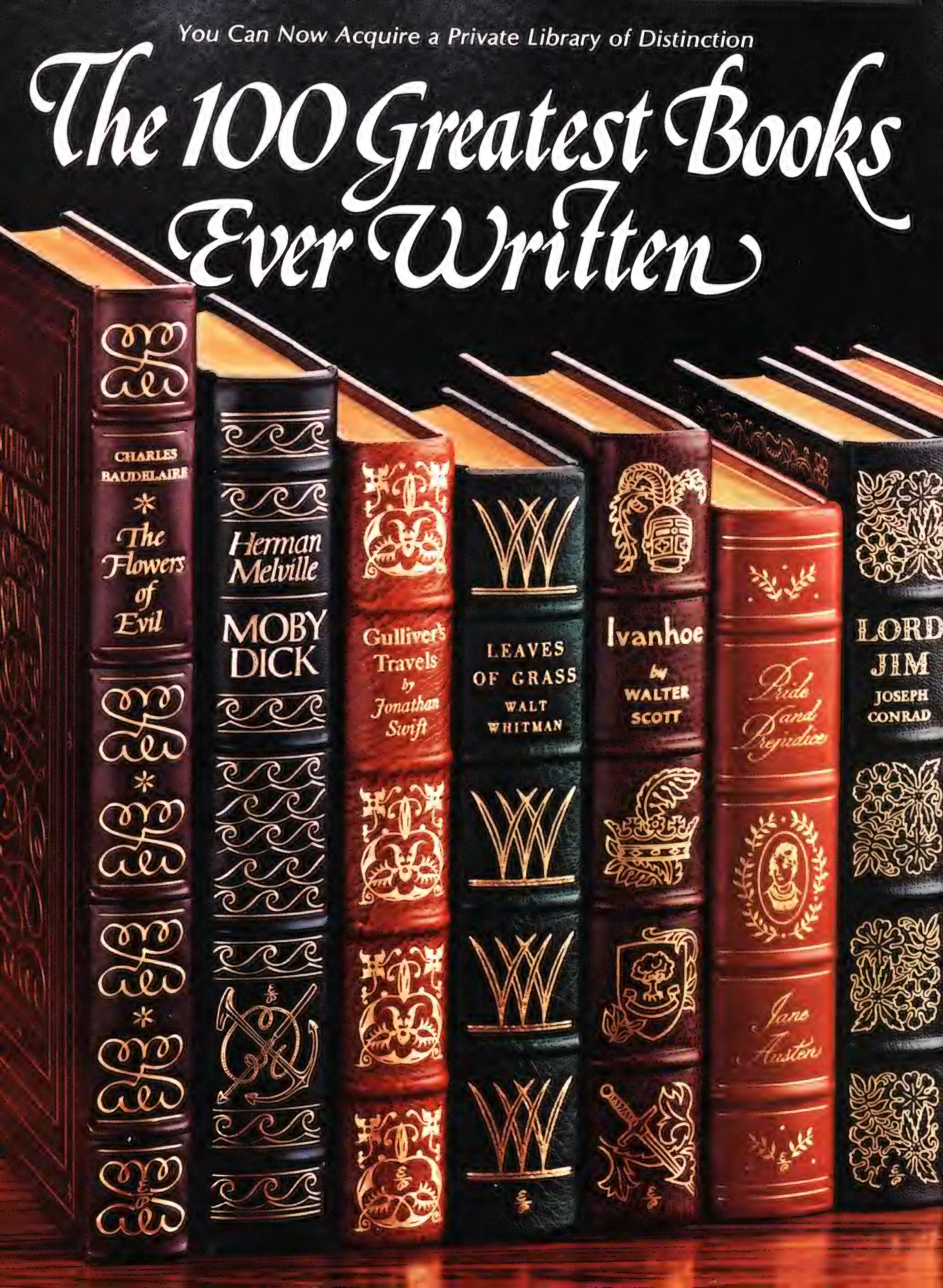

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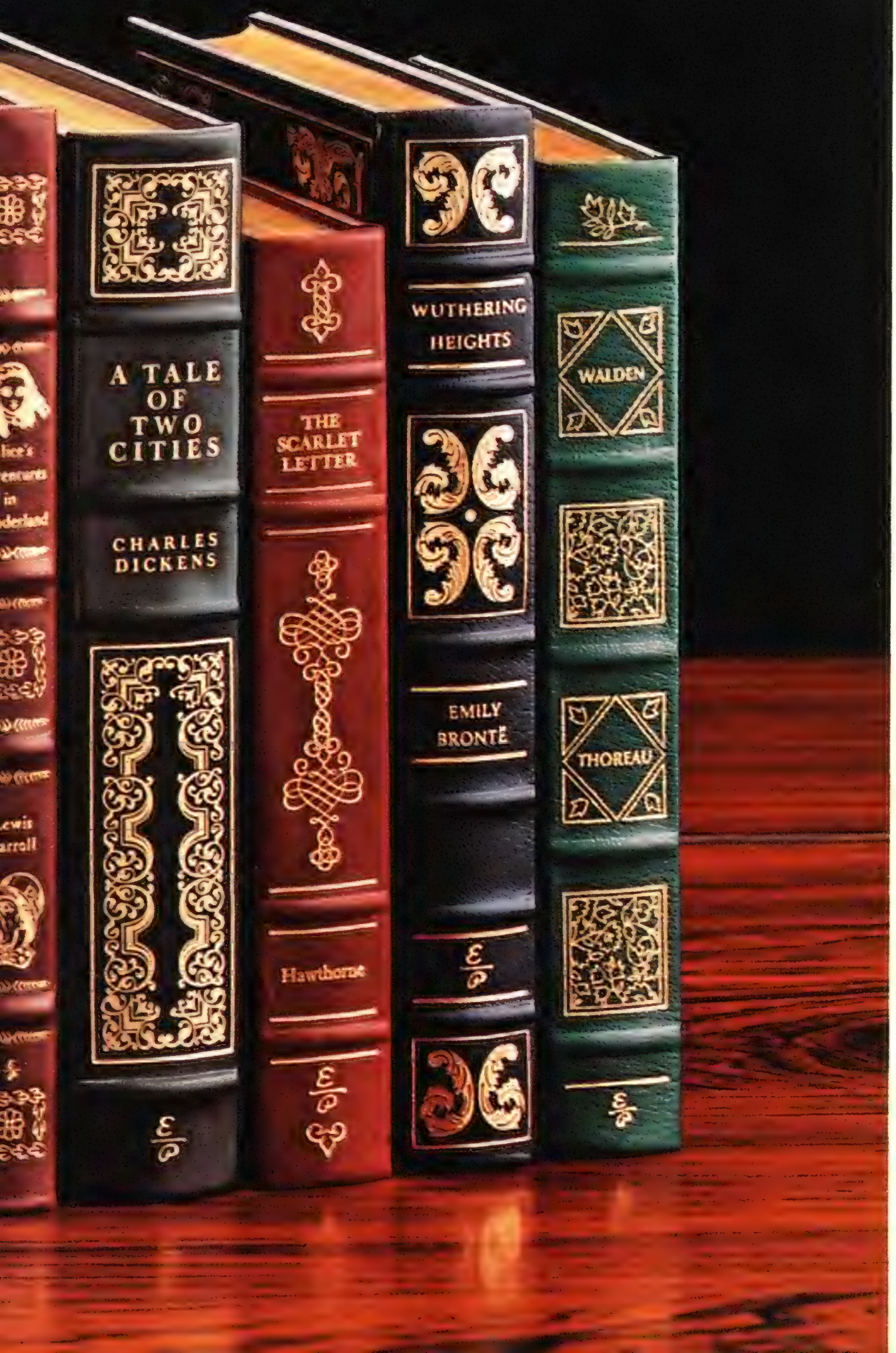


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*(Continued from previous page)*

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# *Around the Mall and beyond*

"The fact is," said Charles G. Barbely, Spacearium Officer at the National Air and Space Museum, "a report by a couple of MIT students stresses the Frisbee's sensitivity to spin rate, while the letter from Princeton seems to say Frisbee aerodynamic performance is practically independent of spin." As he spoke, he fondled a model 119G Frisbee, spinning it absentmindedly on his index finger. I listened intently. This conversation, after all, was to be the Last Word on Frisbees.

"Actually," said Barbely, "the whole subject of Frisbee aerodynamics and performance is wide open. There's been a lot of trial and error but not much serious scientific and engineering study."

"What about the evolution of design?" asked Mel Zisfein, Deputy Director of the Air and Space Museum. "Frisbees have improved over the years, haven't they?" He was doodling on a sheet of graph paper. I awaited Barbely's response, pencil poised above my notebook.

"Well, yes," said Barbely. "Headrick's lines seem to make a difference. They date from 1964. They're supposed to make a Frisbee fly better, but no one seems to know why."

"But lift we *do* know about," said Mel.

"Right," said Barbely. "As an ordinary wing changes its angle of attack . . ."

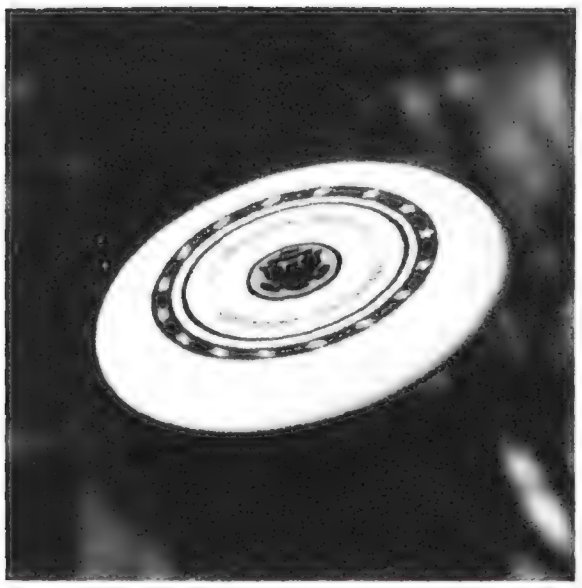
"That's what we call alpha," said Mel.

". . . The lift comes at one-fourth of the way through the wing chord."

"Wow," I said, scribbling.

"But if you should spin that wing and feed in gyroscopic effect, as in a Frisbee," said Barbely, twirling his 119G . . .

". . . The flight path of the wing would be wildly unstable," said Zisfein, making swirling marks on his graph paper, "be-



cause the moment caused by the lift would be very large."

"Whew," I said, warmly.

"So the lift of a Frisbee has to be centered near the half chord to keep it flying straight," said Barbely, giving his 119G a mighty spin.

"The cross section of a Frisbee reminds me of the wing of a 727 jet with trailing-edge flaps and Krueger—that's the forward flap—fully extended," said Mel, sketching a wing chord with two distinct rims, one forward, one aft.

"Uh-*huh*!" said I, enthusiastically.

"It appears the lift of the Frisbee comes very near its center, maybe a little aft," said Zisfein, "because if it weren't nearly centered, the eccentricity would cause the flight path of the spinning Frisbee to veer," he added, drawing a triumphant arrow on his sketch.

"Right!" said Barbely, spinning his 119G to the ceiling and catching it nimbly. "According to theory, the aerodynamic center of a circular wing falls at precisely 52 percent of the chord."

"*Aha*!" I shouted, breaking my pencil.

As the next step in this long-promised Frisbee research, I purchased a Frisbee and two books about them at the National Air and Space Museum shop. The Frisbee is a pretty thing, white plastic with blue and red bands.

In small writing, the Frisbee indicates its parentage—the Wham-O Manufacturing Company of San Gabriel, California. The writing doesn't have to be big because anyone who buys a Frisbee buys a Wham-O. They own the name. Other flying disks have other names.

What I didn't know is that the parts of the Frisbee have names, too. They have been supplied, over the years, by those aficionados who stayed with the Frisbee through its slow start to the burgeoning popularity it enjoys today. Perhaps the ultimate aficionado is Dr. Stancil E. D. Johnson, a California psychiatrist who also describes himself as, among other things, an umbilicalogist. You won't find it in your *Webster's Third*, but you ought to be able to figure it out. Dr. Johnson wrote a short piece on the history of the Frisbee in SMITHSONIAN, September 1976.

In his book *Frisbee* (one of the two I bought), Dr. Johnson notes that the central plate is the cupola; that the little spot of plastic in its center—mine has it on the underside—where the injection was made from the mold machine, is called the bead of Barrett; that the striations on the upper side, near the lip, are those lines of Headrick that Charles Barbely talked about. These mysterious lines are named for the general manager of Wham-O, who patented them.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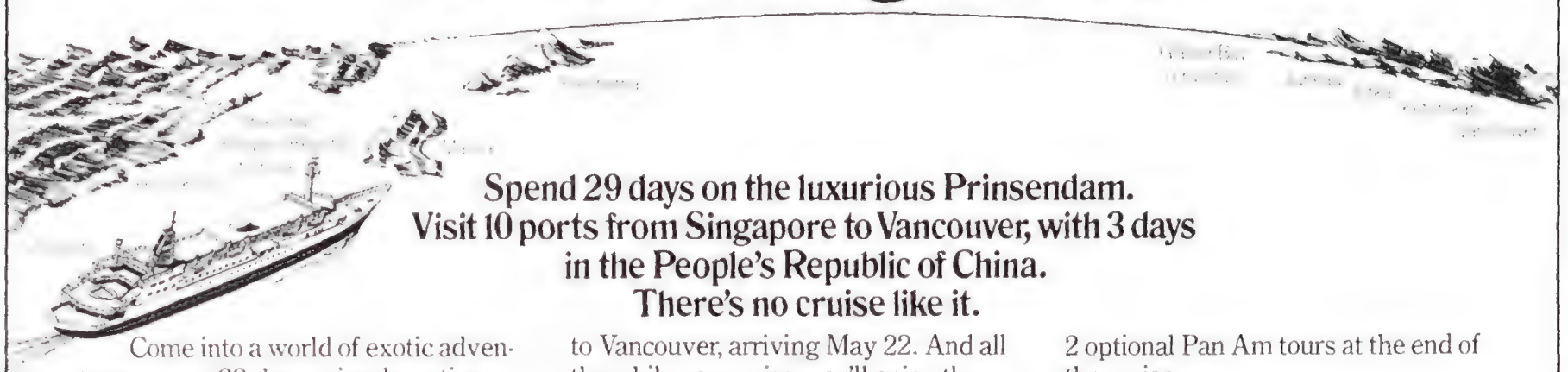

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Some of the rest of the nomenclature is more obscure. There's the slope of Schultz, the minute mound of Malafronte and the seldom seen space of Sewall. The glossary extends to the operation of flying the disk, too. The release is called the whelm. You must whelm it (I can't resist making a verb out of it) with the proper Hyzer angle—tilted away from you, sideways—for it to go straight, since the disk will roll level (a gyroscopic feature) as it proceeds. After the whelm comes the wedge, the well, the wax, the waft, the wane, the wasting, the warp and the was. When you picture an adeptly thrown Frisbee, slung into the air, picking up its proper angle of attack—oops, I mean alpha—soaring to its altitude, hanging there, breathlessly, as its flight carries it far away, gradually sinking, its spin slowing, finally swirling about in a dying spiral and coming to rest, you can see that these are pretty good names.

The companion volume to Dr. Johnson's book is called *Frisbee by the Masters* by Charles Tips, and it contains excellent instructions on how to perform and play various Frisbee games, all illustrated by photographs and line drawings of hirsute young people, blessed with that lean, graceful look that apparently results from a diet of wheat germ and sunflower seeds. Armed with this book, I have been whelming my Frisbee around the corridors of this great publishing enterprise. I have almost destroyed a potted African violet, damaged a colleague's thumb and disrupted a neatly arranged stack of color slides. These disasters are due, I realize, to a certain tubby awkwardness brought about by a diet of escargots, *veau français* and Beaujolais.

But I have developed a formidable wedge, well and wax with a fantastic Hyzer angle. My alpha is superb, with the lift concentrated just behind the bead of Barrett—52 percent through the chord. Not only that: as my own Wham-O settles into its waft, silent and serene, I find I am enjoying myself just as much as Dr. Johnson did, as did also Barrett, Schultz, Malafronte, Sewall, Headrick, Hyzer and many, many others.

This month—in fact, this entire year—sees a dramatic museum program designed by the World Wildlife Fund to promote the conservation of endangered species. It's called "The Animal in Art" (SMITHSONIAN, September and November 1977), and it is an international campaign with about 30 big museums in 11 countries taking part. We at the Smithsonian are, as might be expected, pretty deeply involved in this, and I was lucky enough to poke my head into two of our museums, the Hirshhorn and the Museum of Natural History, in time to see the beginnings of it all.

The Hirshhorn had put together a selection of examples of the animal in art and, as always seems the case, I was surprised by so many little bits of sculpture and painting that include animals.

The Museum of Natural History, meantime, had been going to town with our extraordinary Smithsonian nature photographer, Kjell Sandved. His exhibit of color photographs lined the upper floor of the museum rotunda (above the elephant), an area that is often rather dark and mysterious, but which was suffused with light and joy from these splendid pictures. The title, "Beyond the Ocean, Beneath a Leaf," gives a good idea of what Kjell has covered here: a pustulate cowry feeding on coral, a fan worm larva, a fish-cleaning shrimp, giraffe beetles, weaver ants, an arctiid moth, the eyes of a robber fly, looking like a very sophisticated satellite just fired off from Cape Canaveral.

But more spectacular, even, is Sandved's film *Curious Creatures and Minimonsters*, which brings us very close to his small friends and lets us watch them at their tasks—often through time-lapse photography. This wonderful film will be shown again on January 27 (see Highlights, p. 116).

—EDWARDS PARK

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# *Letters to the Editor*

## *Our culture and our genes*

Dear Sir: The article on human nature by Richard E. Leakey and Roger Lewin in the November issue reminded me of the arguments Bertrand Russell advanced in the Twenties against encouraging physically competitive team sports on logical grounds. He believed that the worthiness of a course of study or recreational choice could be gauged by the degree to which it encouraged a person to see the world more completely and to analyze problems from all possible directions. Individual athletic endeavors and team efforts can encourage a person to develop his awareness of the world as well as of himself. A competitive sport, if it involves physically brutal contact, may prevent him from completely understanding his opponent's point of view—if he did, he might want his opponent to win. Therefore, "they" must be unquestionably inferior, suitable only for losing, while "we" must be superior, the rightful winners.

Russell believed patterns of thought to be habit-forming, and so he felt it obvious that such an unthinking attitude could be transferred to a different religious group, neighborhood, race, nation—anything capable of dividing people. That much of the vandalism associated with sporting events seems to be unrelated to the game itself indicates he was correct.
*Fran Tabor*
Kalispell, Montana

Dear Sir: Leakey and Lewin ask how Man could survive as a species if his genes induced him to kill his fellowmen. Konrad Lorenz says in *On Aggression* (in the same chapter from which he is quoted by the authors) that "the same human faculties which supplied man with tools and with power dangerous to himself, also gave him the means to prevent their misuse: rational responsibility."
*Gerald S. Burns*
Greenville, Rhode Island

Dear Sir: Aggression does not have to be overt (let alone fatal) to function effectively—in fact, once dominance is established, it is seldom manifested overtly. Most animal societies have dominance-establishment and pecking-order systems to limit violent aggression and identify superiority. The problem is that while most animal species deal with each other according to their innate prowess, Man is able to inflict greater harm than is proportionate through the added leverage supplied by the use of a weapon.
*David W. Hamilton*
La Jolla, California

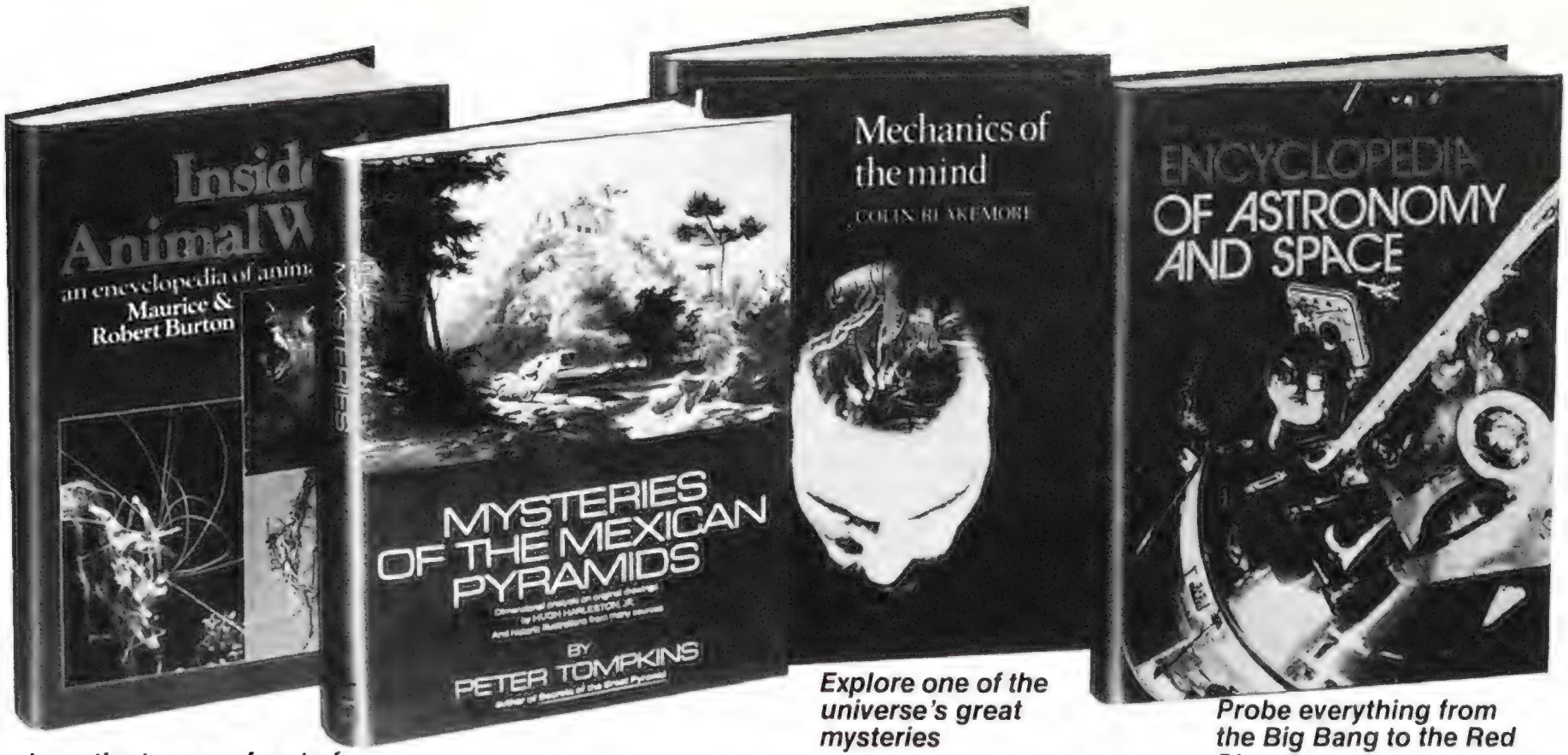
Dear Sir: We have been given, according to the authors, a high intelligence and the ability to combine. We have used intelligence to develop, ultimately, the means to destroy the planet, and our only even temporarily successful international combinations have been associated with warfare against our own species.

Presumably, under evolutionary theory, we have done the best we can, all things considered. Whatever our undeveloped potentialities, in actual biological experience we have developed a pretty bloody society, which I think we have to accept as the best human species response to its genes and world—however depressing such a conclusion may be.
*Richard Clark*
Galena, Illinois

Dear Sir: No crime is committed by arguing that aggression or war is, in part, genetically determined behavior. However, the real crime might result from not rationally considering all of the factors, both genetic and environmental, that influence our behavior. Closing our minds to either might then limit our future options for regulating antisocial behavior.
*Gerald E. Einem*
Columbia, Maryland

## *Beyond black holes*

Dear Sir: In regard to John Gribbin's article, "Concept opening way to a scientific

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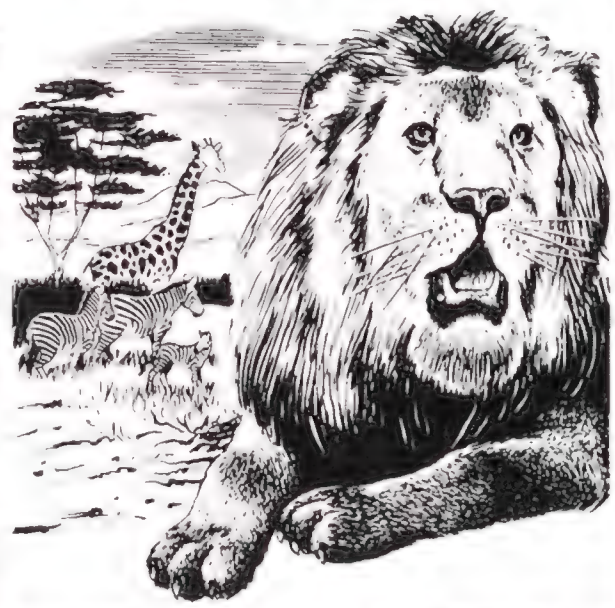

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world of fantasy," I wonder if anyone has thought of what I would like to call a "Reverse Universe" theory.

At this time the "Big Bang" theory is the most widely accepted one to explain the origin of the universe. Now let us assume that the Big Bang was the "outspewing" from a white hole. The concept of a constantly expanding universe through billions of years fits also. But, slowly, something in the makeup of the universe changes and black holes start to appear. By their very nature, more and more matter and/or energy is drawn into them. Their spheres of influence, more and more expanding, counteract (slowly at first—then accelerating) the expansion of the universe.

The moment will come, many billions of years from now, when the expansion is not only brought to a standstill, but reversed! Now a contracting universe shrinks to its doom. The black holes not only get bigger and bigger but also come closer and closer, until there is only one black hole consuming itself. "On the other side" we have an immense white hole spewing out beginnings of a new universe.

*Irene E. McClenaghan*
Piedmont, California

*Miss McClenaghan's theory is a widely held one, called the "oscillating universe," in which the cycle occurs over and over again, approximately every 80 billion years. There is a great debate among astrophysicists as to whether there is enough matter, and therefore gravity, in the universe to make eventual collapse inevitable (a closed universe) or whether there is not, and the universe will expand forever (an open universe).* Ed.

## *A Horatio Alger spoof*

Dear Sir: As a researcher of Horatio Alger's life and works, I appreciate the fact that the current nostalgia craze has revived an interest in this 19th-century author. However, Bill Blackbeard's article, "Novels that boys of a century ago couldn't put down," contains errors that should be brought to your attention.

Alger's father, for example, was not a "fire-and-brimstone preacher," and while at Gates Academy young Horatio was not "a leader in boyish hell-raising." Alger definitely did not carouse with Parisian prostitutes, and his "diary" never existed.

These fanciful notions first surfaced in Herbert R. Mayes' *Alger: A Biography*

*Without a Hero,* published in 1928. Mayes, who intended it to be a spoof on Alger, was amazed when critics praised his efforts. While scores of reference works from then to the present relied upon it, Mayes kept quiet. (The books included the *Dictionary of American Biography* and *Encyclopaedia Britannica.*)

In 1972, Mayes began corresponding with William Henderson, then an associate editor of Doubleday, and gradually Mayes told him the complete story behind his book. "Not merely was my Alger biography partly fictional, it was practically *all* fictional. . . . The project was undertaken with malice aforethought—a takeoff on the debunking biographies that were quite popular in the '20s. . . . Unfortunately—how unfortunately—the book was accepted pretty much as gospel. . . ."

Mayes is currently a member of the Horatio Alger Society and is pleased that the truth about his book is finally out in the open. "For years," he said, "I've wanted to tell the story, especially to one reviewer who gave the book a bad review. He said it lacked imagination."

*Jack Bales*
Editor, *Newsboy*
Horatio Alger Society
Aurora, Illinois

*Mr. Bales also reports that a longtime researcher, Ralph D. Gardner, is about to update his book,* Horatio Alger: or, The American Hero Era, *with new material which should set the record straight.* Ed.

## *The Book of Kells*

Dear Sir: In regard to Alfred Friendly's article in your October issue on the *Great Book of Kells,* I would like to know when and where the exhibition will appear.

*Kathy Robinson*
Denver

*The article listed the cities but not the dates. The exhibition, "Treasures of Early Irish Art: 1500 B.C. to 1500 A.D.," is scheduled as follows: M. H. de Young Memorial Museum, San Francisco (February 21-May 21); Museum of Art, Carnegie Institute, Pittsburgh (June 28-September 24); Boston Museum of Fine Arts (October 24-January 21, 1979); Philadelphia Museum of Art (February 26-May 27, 1979).* Ed.

## *Chimney sweeps*

Dear Sir: In connection with Patrick Ryan's article, "Dirty jobs that require more clean sweeps," a relative of mine in Bollston Lake, New York, recently had her chimney swept by a sweep in a top hat and tails. She said he didn't leave a speck of soot. The chimney sweeps in that neighborhood are doing a rushing business.

*Constance S. White*
McLean, Virginia

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From sea to shining sea, America is blessed with an abundance of stunning birds and flowers. A glorious, spirited patchwork of sound, color and fragrance.

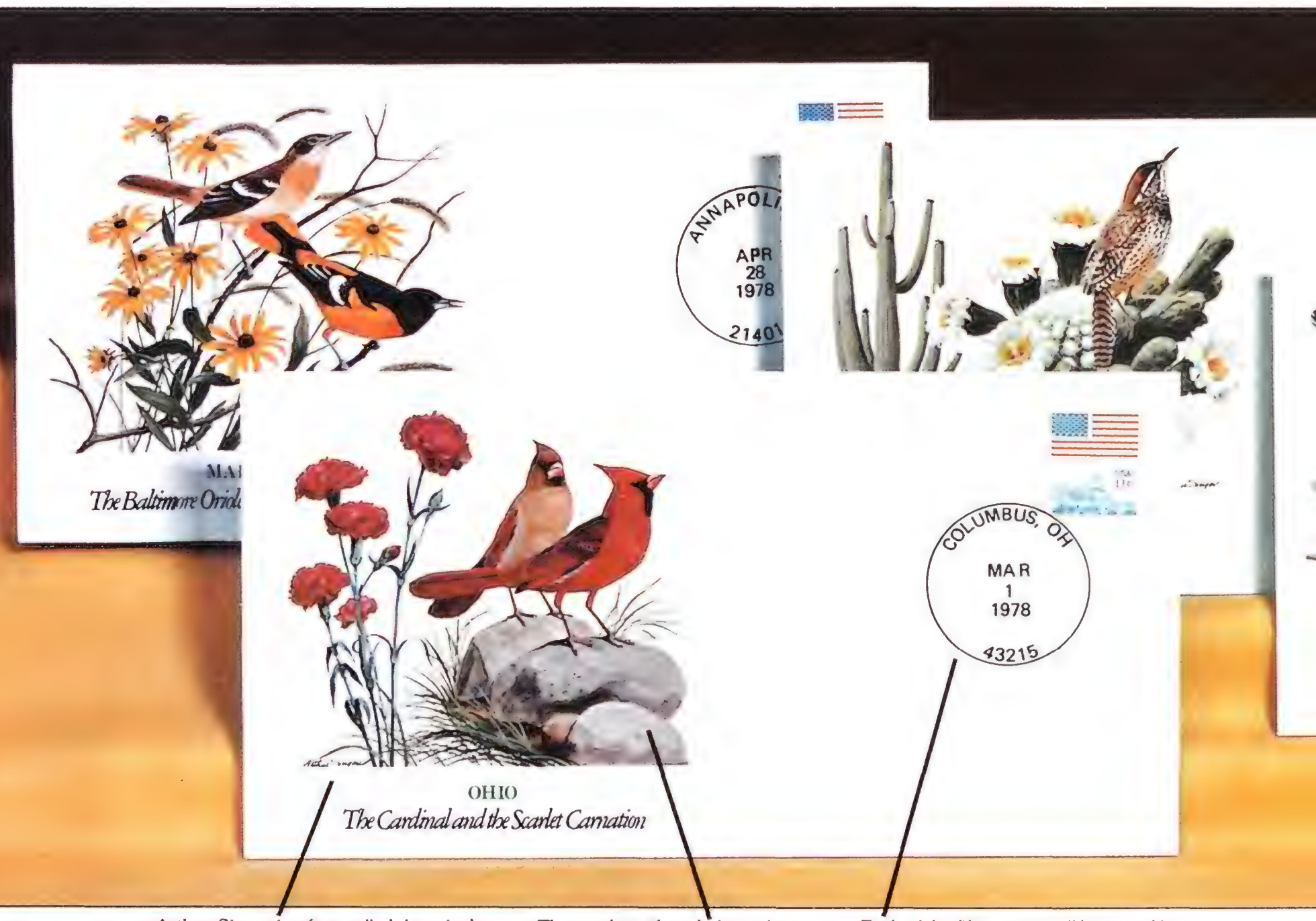
In every state, nature's beauty abounds. Americans know it, and are proud of it. And with each new song a bird sings, and each new flower that blossoms, that pride is renewed and strengthened.

To forever affirm this pride and respect for the natural environment, each of the fifty states has chosen an official state bird and flower as a lasting acknowledgement of nature's bounty. Seen together, as they are in this collection, *The Birds and Flowers of the 50 States* capture the total richness of the great American outdoors, and prove that nature, in all her glory, is an everlasting part of America the Beautiful.

It is appropriate, therefore, at a time when Americans are dedicating themselves to preserving and protecting the natural environment, that America's foremost conservation group — the National Audubon Society — has appointed Fleetwood to issue the *first* philatelic collection honoring these living symbols of the United States.

### Fifty original works of art by America's greatest wildlife artist

Each of the commemorative covers in *The Birds and Flowers of the 50 States* is a triumph of craftsmanship and design by a man who is often called America's greatest living wildlife artist: Arthur Singer. For nearly two years, Arthur Singer has labored to achieve the perfection and absolute fidelity to nature that a collection of this importance




Covers shown reduced from actual size of 7½ by 3⅛ inches.

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The *cachet* of each issue is an original painting of the state bird and flower by Arthur Singer, perfect in every detail and true to nature's colors.

Each of the fifty covers will be issued in the appropriate state capital on the anniversary of statehood, and will be officially postmarked to certify that it can never again be issued.

deserves. As a result, collectors who acquire these fifty covers will own what is surely the most comprehensive, most authentic tribute of its kind ever issued.

Singer's paintings capture each bird in its true colors and shadings. The flame-red plumage of Ohio's Cardinal. The startling brightness of New York's Bluebird. The dramatic orange and black contrast of Maryland's Baltimore Oriole. The head, the feathers, the beak and the tail of each bird is shown in exquisite, and accurate, detail.

### A rainbow of floral colors

The state flowers, from the delicate blossoms to the graceful leaves, are just as real. And the colors! The bright orange of the California Poppy. Breathtaking Texas Bluebonnets. Soft pink, sweetly-scented Mayflowers from Massachusetts. Here is a collection which forms a rainbow of floral colors, textures and shapes — a dream garden filled with America's most beautiful flowers.

Arthur Singer has created *fifty* perfectly-colored, perfectly-detailed masterpieces for *The Birds and Flowers of the 50 States*, making this a landmark collection that will be praised by collectors and nature lovers for years to come.

### Historic postmarks

Significantly, each of the fifty covers will be issued in the appropriate state capital on *the precise anniversary of statehood*. There, each will be officially postmarked by the United States Postal Service. The covers honoring the thirteen original states will be issued on the anniversaries of their ratification of the Constitution. Thus, the collection is not only a worthy tribute to the official state birds and flowers, but, as the postmarks certify, a collection which can never again be duplicated.

### Surprisingly modest cost

Normally, a collection of this scope, by an artist with the international reputation of Arthur Singer, would be beyond the reach of most collectors. Therefore it is significant that the original issue price for *The Birds and Flowers of the 50 States* is a very modest $2.50 per Commemorative Cover. This price is guaranteed for the entire collection, and a deluxe collector's album is included at no additional cost.

Subscribers will receive issues at the convenient rate of four per month for twelve months. The twelfth shipment will include six issues. Shipments may be paid for by check or money order, or automatically billed to a credit card account.

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# *Phenomena, comment and notes*

*Whiplash, book preservation, a minor debt to the Indians, virtues of slow and low, and the latest pros and cons on electric cars*

An inventive gentleman stopped by the other day, having arrived via his electric car. A large, expansive man named John Hoke, he is employed by the National Park Service to tinker with things in order that matters will go more smoothly in the parks. The philosophy of this former biologist and electrical engineer is that we should think slow, rather than fast, and as a result Hoke is considered an eccentric. (It is nice to know that a department of the federal government has room for eccentrics.)

The Park Service has in its control, he said by way of example, a goodly number of old millers' waterwheels that were converted to electrical generation and, owing to their inefficiency, lapsed into idleness. The inefficiency was the result of trying to gear up a slow-moving waterwheel to work with the faster requirements of an alternator. Why not change the requirements of the alternator, Hoke asked an engineering firm, making it slower in order to match the speed of the waterwheel? The firm's computer responded

The Smithsonian Institution's own electric car.


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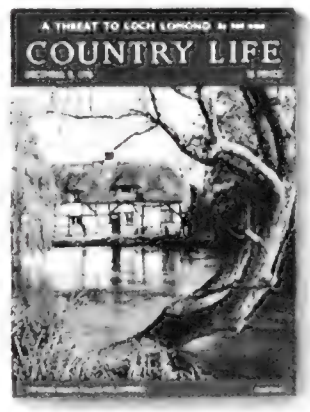


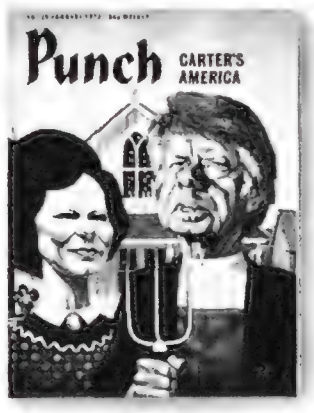


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that it is possible theoretically (it's just that no one asked the question before, the engineers said).

Through what the uneducated would call idle tinkering, Hoke also found that the material used in those night-lights that glow dimly in the dark and were recently the rage was ideal for parks and other similar situations. The low-level light doesn't scare away nocturnal animals yet permits the human eye—once adjusted as in a movie theater—to see 100 feet. At the same time the light is low enough so it doesn't interfere with human sleeping. But, if left blinking throughout the night, it might annoy and scare away those creatures such as bears that you don't want to share your tent. Furthermore, a few solar cells attached to it will keep the batteries charged. "No one was interested in this before," said Hoke, "because the light wasn't *bright* enough. Along with thinking slow, one can also think low, as in the case of these lights."

With this in mind one turns to a report in *Environmental Science & Technology* (Vol. 11, No. 9) in which Edwin C. Hackleman jr. of the University of Connecticut reviews the status of electric cars, known in the trade as EVs:

- When gasoline gets to $1 a gallon (how far off can that day be?) the total cost per mile of an EV would be 9.1¢ a mile, as opposed to 16.5¢ for a gas-driven compact.
- The short range of the current EVs—about 50 miles before recharging—is ideally suited for the vast proportion of automobile use in this country: fleet operators such as the Postal Service, commuters (the preponderance of whom drive less than 30 miles a day and could recharge their EVs before driving home at night) and city drivers in general.
- The internal-combustion vehicle is least efficient when it must do a lot of starts and stops. It uses approximately one cup of gas per six minutes of idling. An EV uses no energy when not moving.
- Having so few moving parts, the EV is almost repair-free. (Every now and then, EV users have to replace things like brushes on the electric-drive motor.) The main breakdown, says Hackleman, is in the batteries. People might let them run down too far. And this leads to a review of the EVs disadvantages:
- Mainly, the battery. Current lead-acid batteries wear out after too many rechargings. Other longer-lived and higher-powered batteries are too expensive so far. The best on the horizon is the sodium-sulfur battery which, according to Hackleman, has a high-energy density and is made of inexpensive materials.
- The EV merely removes pollution from the streets to the utility-plant smokestack, claim its detractors. But not only is it easier to control emissions from a few smokestacks than from millions of cars, says one utility company spokesman, but "we could recharge 500,000 EVs at the low-load-night period without any change in smokestack emissions."
- The main obstacle, it seems, besides the inertial force of capital tied up in the internal-combustion economy, is that EVs are different. They don't look like real cars (and keep in mind that we Americans, the greatest of innovators, accept certain changes with a churlish minimum of grace).

On the other hand, the fact that EVs look strange may be a considerable advantage, at least, as is often the case, for the pioneers. When John Hoke left us he led a small curious band out to look at his red CitiCar parked on the street. All the other cars had received tickets with the usual precision of Washington, D.C.'s finest. But, bending over the CitiCar (which looks like a cross between a golf cart and a packing carton) and peering in at its odd-looking instruments, used for monitoring performance, was a puzzled policeman. If it isn't a car, he seemed to be saying to himself, then it can't be illegally parked. No ticket.

### *Indian food with a prize*

Many of us acknowledge the various debts we owe the American Indians—corn, squash, nice names for towns and automobiles, and so forth—but a lot of people are a bit nervous that, in calling in the debts, the Indians will make off with over half of the state of Maine, a fair-sized Cape Cod village, parts of New York and much more.

Those matters are far beyond the scope of this column. But another minor debt emerges from *Search* magazine (Vol. 3, No. 1) wherein Dean Snow reports on the state of archaeology in New York. He writes: "One of the first whites to visit the Iroquois wrote that he was served popcorn over which hot maple syrup had been poured: we now call [the same] thing 'Cracker Jack.' "

*Whiplash revealed*

Whiplash, that perennial bane of automobile-insurance companies, has always been hard to prove, but now, for the first time, a Johns Hopkins radiologist has found a visible sign of whiplash in x rays, (*Medical World News* Vol. 18, No. 22).

By taking a "lateral extension" view (that is, x-raying the patient from the side with the head bent back), Dr. Paul S. Wheeler found a small light spot on the film near the upper or lower front edge of the midcervical spine, called a "vacuum cleft," the result of the anulus fibrosus being pulled away from the bone. And that means definite whiplash—just one example of the many severe hyperextension injuries a lateral-extension view can reveal. Radiologists have heretofore overlooked the tiny spot, perhaps believing it to be an artifact in the film. Dr. Wheeler warns that if a patient doesn't exhibit a vacuum cleft, it doesn't necessarily mean an absence of whiplash. However, in time his discovery should allow detection of true spinal disc injuries that otherwise would be missed. Another technique is to ask patients if it hurts when they swallow. "They can't fake that—they don't know the right answer," says another radiologist, Dr. Don C. Weir, of the Saint Louis University School of Medicine. "If there is no pain swallowing, you're quite sure they don't have hyperextension injury."

Now *you* know the answer.

*Trouble with books*

If magazines are like books, you probably won't be able to read this issue of *Smithsonian* in 60 years. Books, say the Library of Congress, are self-destructing because of acid—in the paper, the old manuscript inks and pollutants in the air. About 40 percent of the Library's 17 million books, says *Chemistry* (Vol. 50, No. 8), are too brittle to be lent out. Other tests have shown that virtually all of the nonfiction books published between 1900 and 1940 will be useless by 2000. What to do?

One suggestion is to build a time-capsule type of repository in a salt mine for one each of every book published. Another is a deacidification process now being tested in Canada whereby books are treated with liquified gas solutions in a pressure chamber.

—James K. Page jr.


# Fermentation: The miracle that turns the juice of the grape into wine.

Although it is an oft-proclaimed truth that fine wine is a living growing thing, nowhere is this more evident than during that critical, and still somewhat mysterious, process called fermentation.

**Yeast: The Catalyst**

It is possible that a quantity of fine grapes crushed and left to themselves in an open container will, in time, ferment and yield an acceptable wine.

It is probable, however, that these same grapes will yield a wine not so pleasant.

Which it will become depends on the vagaries of simple, one-celled plants called yeasts which are found naturally in the bloom on the skins of grapes.

**A Louis Pasteur Discovery**

Until 1864, wine-making was a matter of uncertainty. But then Louis Pasteur discovered that these yeasts were, indeed, the agents that caused fermentation.

Equally important, he discovered that specific strains with desirable characteristics could be isolated and substituted for the wild yeast in the wine-making process, a major step toward predictable excellence.

Today, our winemakers are devoted to the study of yeasts and to their improvement. Because no one yeast works equally well in every case, we are constantly striving to isolate the ideal yeast for the different varieties of wines.

This development of the specific yeast which maximizes a grape's natural flavor potential is a primary study we have pursued for years.

To achieve a wine of predictable excellence year after year, we developed the first successful dehydration of pure wine yeast. The dehydrated form maintains the consistent purity from year to year and provides us with a "cleaner" wine that is truer in flavor and fragrance to the grape.

**Some Like It Cold**

During fermentation, heat is created. If we permit the fermenting juice or "must" to attain a temperature of only ninety degrees, the yeast can be injured. At one-hundred degrees, most yeast will die.

Over the years, we have developed precise cooling methods for keeping the fermenting liquid at the optimum lower temperature. This varies from grape to grape. For example, the Sauvignon Blanc, French Colombard, Chenin Blanc, Riesling or Chardonnay we use for our white wines are far more delicate and sensitive to temperature than their more robust red cousins.

We determined that fermenting them at a cooler temperature slows the change from juice to wine and protects the delicacy of the resultant wine.

In this cooled state, the juice can ferment as long as fourteen days rather than three or four.

**The Test Fermentation**

Knowing the precise moment to draw the wine is a combination of the skill and art of our winemakers.

In some cases we actually take grape samples a few days before harvest and, on a small scale, proceed with fermentation. This gives us a preview of what to expect, and, we then make whatever adjustments necessary to produce the most consistently excellent wine.

**The Reason For All This Care**

It is only by utilizing all the skills gained in many years of work and study that we can achieve our intent: to bring you the finest wines that we, or anyone else, can provide.

*Ernest & Julio Gallo, Modesto, California*

# executive health

the report that briefs you on what to watch


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Linus Pauling, Ph.D.

# VITAMIN C AND HEART DISEASE

## Can vitamin C protect you, and how much should you take?

Heart disease and related diseases of the circulatory system are the main cause of death in the United States. Over one million people die of these diseases each year, and probably more than five million people now living are suffering from them in a significant way.

There is no doubt that heart disease is related to the diet. In the 1976 Congressional Hearings on the relation between diet and disease the nation's top health officer, Dr. Theodore Cooper (Assistant Secretary for Health in the Department of Health, Education, and Welfare), stated that

> "While scientists do not yet agree on the specific causal relationships, evidence is mounting and there appears to be general agreement that the kinds and amount of food and beverages we consume and the style of living common in our generally affluent, sedentary society may be the major factors associated with the cause of cancer, cardiovascular disease, and other chronic illnesses."

For about 25 years the major culprits in cardiovascular disease have been thought to be saturated fats, cholesterol, and related fat-like substances (lipids). A tremendous campaign has been waged to promote diets with low cholesterol, low saturated fat, and increased polyunsaturated fat. Despite this campaign, the death rate from cardiovascular disease has remained constant during the last 25 years, and it now seems to be almost certain that the assumption that heart disease is caused by a high intake of saturated fats and cholesterol is wrong.

This development does not mean that diet is not important. A high intake of ordinary sugar greatly increases the incidence of cardiovascular disease (see "Sugar: Sweet and Dangerous" in *Executive Health*, Volume 9, Number 1, 1972). Moreover, much evidence has been gathered recently to show that cardiovascular disease can be controlled to a considerable extent by the proper use of vitamin C.

### What is cardiovascular disease?

The general term cardiovascular disease comprises various diseases of the heart and blood vessels. Arterio-


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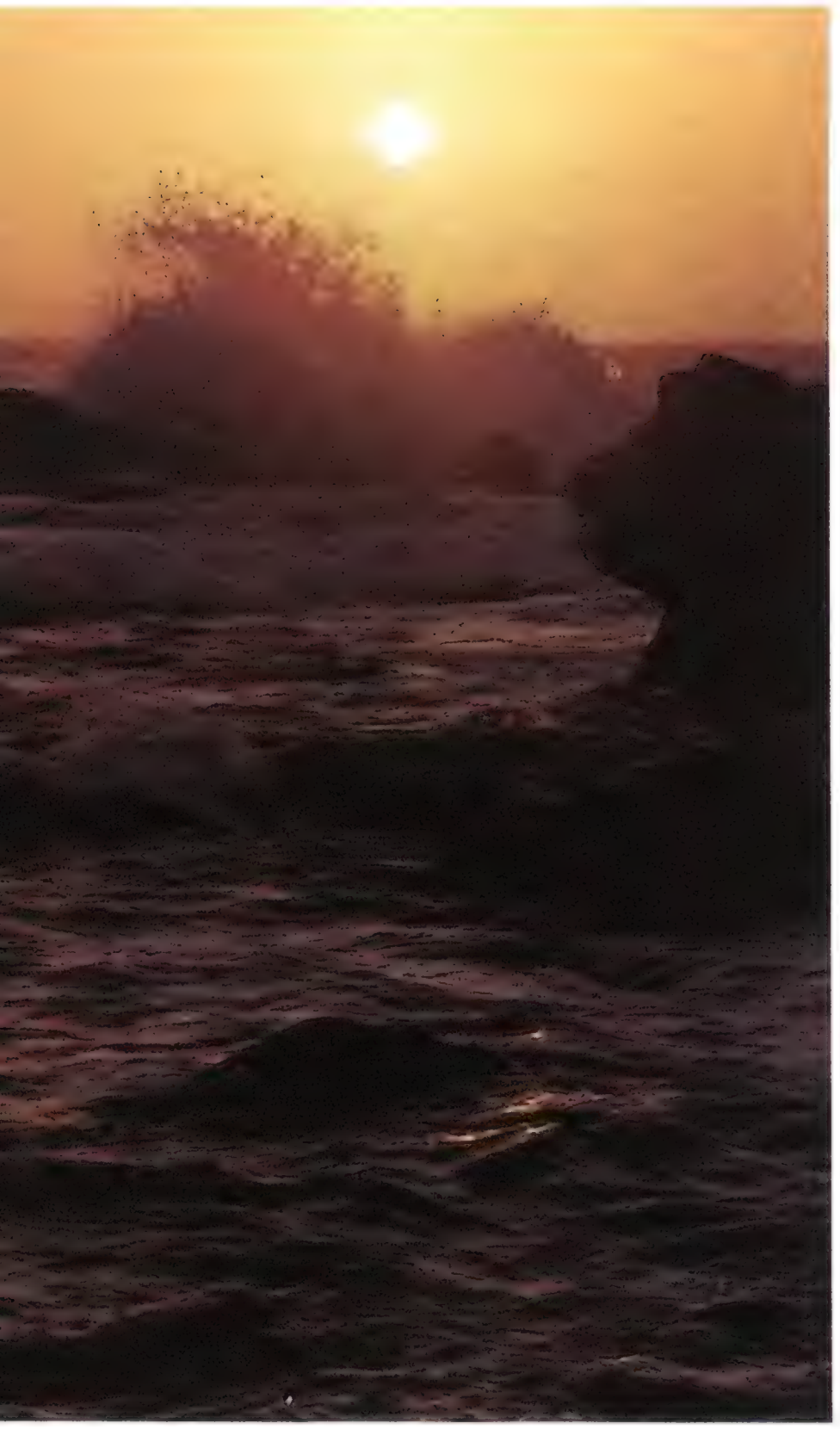
*By Nigel Calder*

# Head south with all deliberate speed: ice may return in a few thousand years



Height of sun from horizon and its apparent diameter critically determine effect of solar radiation on Earth's climate. Summers at this site near San Diego will be cooler in future.

I have before me a learned paper about the ice ages, first published in 1952 and reprinted as recently as 1970 by a distinguished American geologist in a book of readings for students. The author states that "altogether, at least four cases of glaciation advancing to moderate latitudes are known. . . . It seems that the duration of each . . . was not very long, perhaps a few thousand years; the interglacial periods were probably longer, 100,000 years or more." He refers scathingly to "the so-called 'astronomical theory' of the ice ages, which pretends to account for these climatic changes by variations in . . . the earth's orbit . . . the 'astronomical' chronology of the ice ages must be stamped as illusory and rejected *en bloc*."

These statements, we now believe, are incorrect. "At least four cases" is understatement to the point of error: not less than seven major glacial advances have occurred in the past 700,000 years alone, and possibly 20 since the present series began two million years ago. The cold phases have lasted much longer than the warm ones, which are typically 10,000 years long, not 100,000. Finally, far from being "illusory," the astronomical theory has emerged from among a host of rival theories as the most plausible explanation for the repeated advance and withdrawal of the ice sheets.

Because of new discoveries, glacial periods can no longer be regarded as remote geological events, to be filed at the back of one's mind with massive meteor showers, rampant volcanism and carboniferous jungles. They have been *dominant* features of the Earth's climate during the last two million years or so, and they intermittently put Canada, Scandinavia, Siberia and other huge areas into a prolonged freeze under blankets of ice a mile or more thick. Antarctica and Greenland display remnants of ice from the last glaciation, which ended some 10,000 years ago. The realization that 10,000 years is the typical dura-

*During the next centuries, greenhouse effect may warm Earth dramatically, but after that our big glaciers will start to get bigger*

tion of interglacials, like the one in which we are living, has provoked a new concern among climatologists about when the ice may start to advance again, and what the initial cooling phases may do to agriculture on a global scale.

The astronomical interpretation of glacial aggrandizement is also known as the Milankovitch theory, after the Yugoslav Milutin Milankovitch, who did not originate it but for many years was its most tenacious advocate. The essence of his view is that the glaciation occurs when critical zones in the Northern Hemisphere receive less heat from the sun in summer than needed to melt the winter snows. Unmelted, the snow piles up year by year into ice sheets which, because of their enormous weight, act like viscous solids and creep over the landscape. According to the theory, the summer sunshine varies because of cyclical changes in the orientation of the Earth's axis in space and the shape of its orbit (p. 34). These variations govern the timing and extent of glacial episodes.

It is all a question of how the Earth's supply of solar energy is distributed. The sun's altitude at noon and its apparent diameter are key factors in determining how much energy falls upon each square mile of land and water during the day. Suppose you were a long-lived and careful observer on the shores of Southern California. The way the sun looked to you as the centuries rolled by would be a rough guide to the experience of the Northern Hemisphere as a whole, and also to whether the snow on the Sierra Nevada would melt reliably each summer or spawn new glaciers as it did a while back.

Because the Earth acts like a gyroscope while orbiting the sun, its axis points more or less in one direction. The North Pole is tilted toward the source of energy in our summer and away from it in our winter. Accordingly, in California or anywhere else in the

An exit glacier in 700-square-mile Harding Ice Field, Alaska, shows on a small scale how pressure of snow and ice, accumulating at center, forces periphery to move, slowly crushing all in its path.

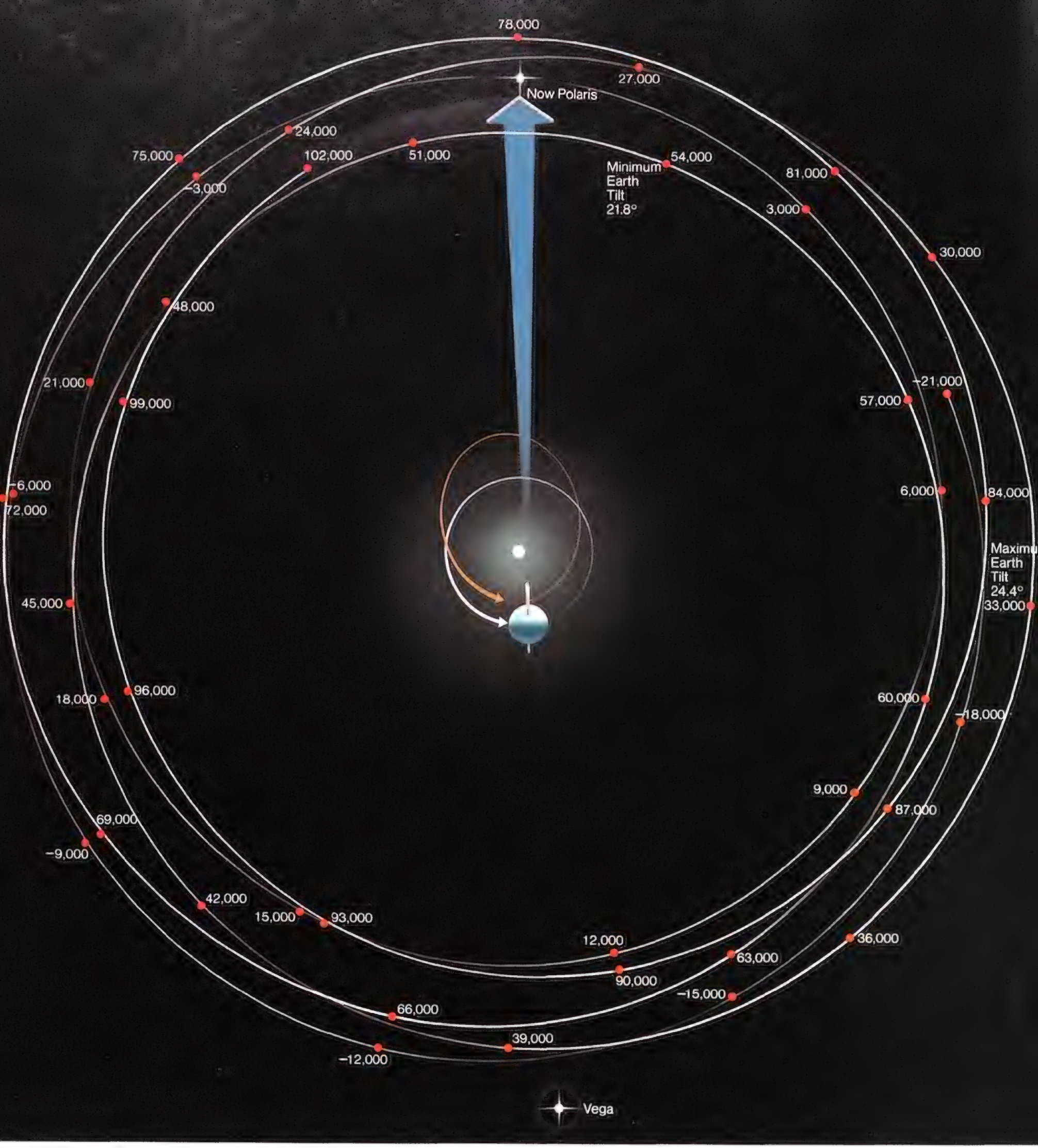
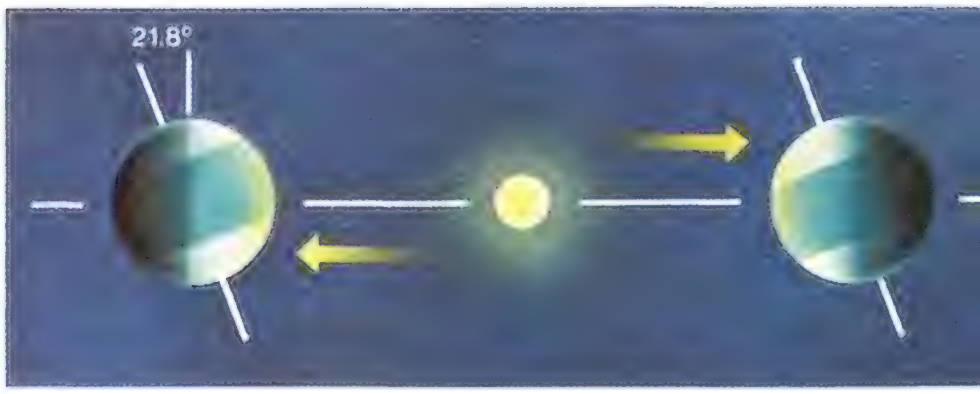



Diagram shows operation of two of the three main forces which, in combination, subtly disperse or concentrate solar radiation and produce recurrent ice ages. Midsection depicts gradual deformation of Earth's orbit from circular to elliptical and back again in a cycle of 102,000 years (see p. 35). The overlapping lines along the periphery demark at arbitrary 3,000-year intervals the precessionary "wobble" of the planet's rotational axis owing to lunar and solar torque acting on the equatorial bulge. North polar axis now points toward Polaris, but in 15,000 A.D. it will be aimed at Vega. The complete cycle varies between 19,000 and 23,000 years, depending on the eccentricity of the wobble.




Another major cause of periodic massive glaciation is the fluctuation of the angle of the Earth's axis in relation to the plane of its orbit. This axial tilt ranges between 21.8 and 24.4 and is now heading toward the minimum from 23.5. A steady decline in global mean temperature (see below) will result.

Northern Hemisphere, the noonday sun appears much higher in the sky in summer than in the winter; that is the basic cause of the changing seasons. There are subtler features, though, that explain the rhythm of the ice. The sun is measurably "bigger" in January than in July, though the difference is invisible to the naked eye, because the Earth's orbit carries it three million miles closer to the sun during the northern winter; as a result, the intensity of insolation (solar radiation) on the Earth as a whole is some seven percent greater in January than in July. We in the Northern Hemisphere don't feel very warm, of course, because the tilt of the Earth spreads incoming sunlight over a broader area than in summertime.

A corollary is that the sun is "cooler" on the summer beaches of California than, shall we say, in Sydney, Australia, during its summer. But in 10,000 years these conditions will reverse and the planet's closest approach to the sun will occur in the *northern* summer. The cause of this effect is the precession of the equinoxes: solar and lunar gravitational torque acting on the Earth's equatorial bulge cause the two annual equinoxes to occur slightly earlier each solar year within a cycle of 26,000 years.

These forces also cause a slight "wobble" that changes the orientation of the Earth's rotational axis within 19,000 and 23,000 year cycles. How do we know? Aside from the classical Newtonian proofs, we see evidence of the movement in ancient architecture. A shaft in the pyramid of Cheops designed to admit the light of the star Thuban now points at a quite different part of the sky, but in some 19,000 years it will again be aimed where the priests wanted it. For our purposes, it is sufficient to keep in mind that the wobble of the Earth's rotational axis is one of the three major causes of periodic glaciation because it acts to diffuse or concentrate solar radiation in certain critical areas on the surface of this planet.

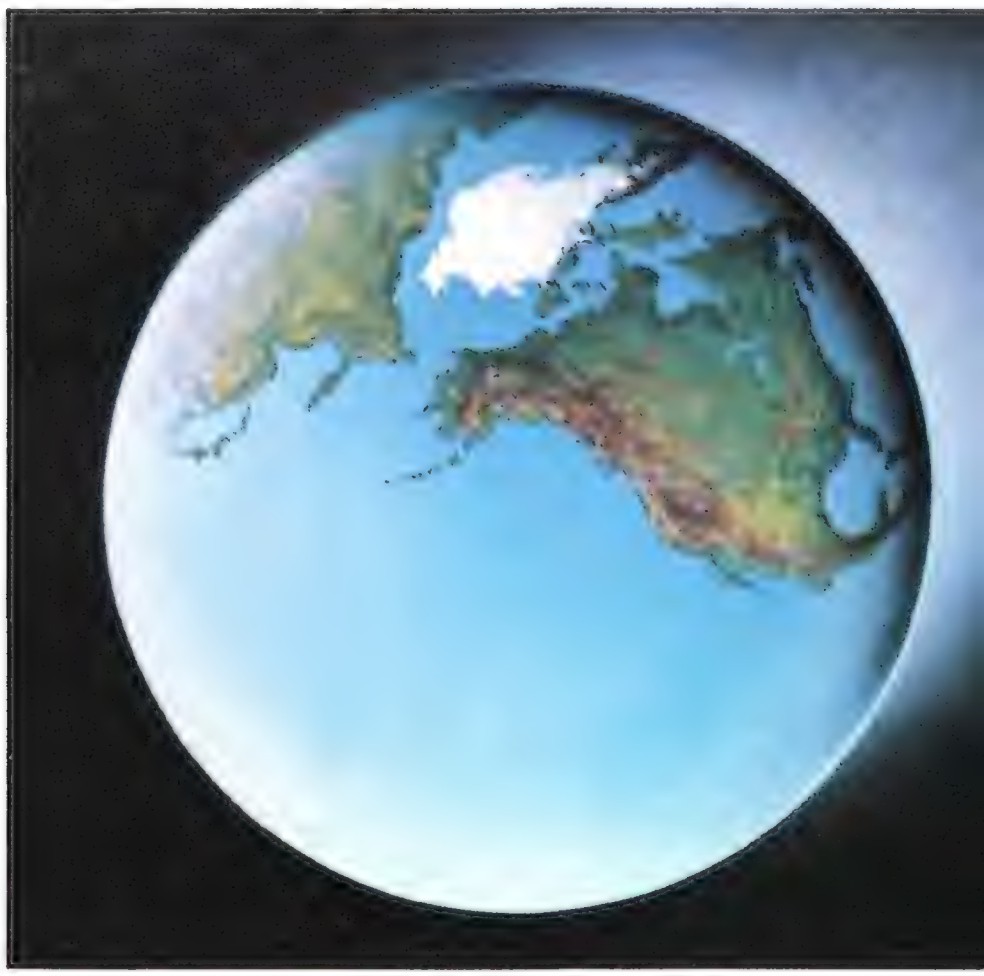
The maximum height attained by the sun in the sky over our California beach also varies. The Earth slowly rolls to and fro, altering the angle of tilt of its axis in relation to the plane of its orbit around the sun. At maximum, the tilt is 24.4 degrees; at present it is 23.5 degrees and diminishing toward a minimum of 21.8. The complete cycle, back and forth, takes about 42,000 years. As a result, in the millennia ahead the sun will ascend less high in the summer skies of California than it does at present and summer there will become correspondingly cooler, thus from time to time counteracting the periodic warming trend in the Northern Hemisphere due to the precessional changes noted previously.

The third factor is that the shape of the Earth's orbit slowly fluctuates. Sometimes it is almost a perfect circle; at other times it is more eccentric—in other words, the nearest and farthest distances from the sun differ by more than the present three million miles. The greater the eccentricity, the closer the Earth comes to the sun at perihelion—its point of closest approach—and the more intense is the annual spell of maximum radiation. The change in eccentricity is cyclical, repeating itself in a period of about 100,000 years. Significantly, that is the repetition rate for the episodes of deepest glaciation, and these coldest spells correspond with the times of *minimum* eccentricity. That is, a circular orbit results in glaciation because the planet does not warm sufficiently in summer to melt the winter snows. It is worth noting that the eccentricity of the Earth's orbit is now diminishing.

The combined effects of wobble, tilt and varying orbital eccentricity mean that the intensity of seasonal sunshine at any one place rises and falls in a complex, but predictable pattern. They must be considered separately in order to show how they effect the climate.

Revising the "four-ice-age" theory depended mainly on 20 years of painstaking analysis of columns of mud

*British scientist-author Nigel Calder writes on everything from quarks to quasars. He is author of* The Weather Machine.



Floating polar ice already displaces its own weight in water, thus would not raise ocean level if it melted.

retrieved from the ocean bed by deep-sea drilling. The shells of small marine animals taken from these "cores" reveal a subtle and undisturbed record of the Earth's changing climate. Among techniques for deducing the climate from these remains, two have been especially refined in recent years. One method is ecological: under the microscope the paleontologist counts relative numbers of fossil remains of different species which are known to favor warmer or cooler conditions, and can then estimate to within one-third of a degree the mean temperature of the sea surface at the time the animals lived. The second method is measurement of the relative abundance of two isotopes of oxygen in the shells: ordinary oxygen 16 and the heavy isotope oxygen 18. As water evaporates from the oceans to form ice sheets, molecules containing the heavy isotope tend to be left behind in disproportionate amounts because they are slower to evaporate. The oxygen incorporated into the shells of animals then living reflects this ratio.

From the outset the ocean-bed cores showed a much more rapid succession of ice ages than geologists had hitherto perceived in the terrestrial record. Important confirmation on land that there were indeed many ice ages came in the early 1960s. However, dating remained an issue, both in figuring out how old a given layer of mud might be and in coping with irregularities in mud deposition rates. The detection in some cores of a reversal in the Earth's magnetic field known to have occurred three-quarters of a million years ago finally provided a reference point. When the curves of changing climate were properly adjusted, they plainly matched at least one of the Milankovitch cycles, a 100,000-year cycle in orbital eccentricity, and they matched it seven times in the last 700,000 years.

A more sensitive and definitive test of the Milankovitch theory was to find the more rapid fluctuations due to the precessionary wobble and the tilt of the Earth's axis. That test was undertaken in the mid-1970s by James D. Hays of the Lamont-Doherty Geological Observatory, John Imbrie of Brown University and Nicholas J. Shackleton of Cambridge University. They selected two marine cores taken from the southern Indian Ocean, which together spanned the last 450,000 years of the Earth's history. They measured sea-surface temperature variations and the changing oxygen-isotope ratios, and took as a third climatic indicator variations in the fossil abundance of a marine creature, *Cycladophora davisiana*, which flourishes in that region during cold spells but almost disappears when the climate is warm.

Their analyses produced a mass of raw data for each indicator, which was then checked by computer for the presence of regular cycles. The result was clear evidence for the Milankovitch theory. In one 42,000-year cycle all three climatic indicators demonstrated the tilt of the Earth. As for the wobble, where there are two periodic components, one of 23,000 and the other of 19,000 years, both showed up as separate peaks in two of the indicators, sea-surface temperatures and oxygen-isotope ratios. Milankovitch seemed vindicated more thoroughly than he could ever have dared hope, though some scientists still remain skeptical.

While competing hypotheses continue to appear in

Glacial maximum 17,000 years ago covered vast areas of Northern Hemisphere with mile-thick ice sheets.

print, many an expert or onlooker has been converted. For me, persuasion was a two-step process in 1974, starting with Imbrie's showing of early analyses of ocean-core data which revealed the first signs of the Milankovitch cycles coming through, and finishing with weeks of intermittent play with a pocket calculator. I finally satisfied myself that I could deduce from the insolation tables a history of formation and melting of the ice which more or less reflected the climatic record. Other investigators took a fresh look at the long-standing controversy about whether relatively minor changes in seasonal insolation were sufficient in principle to account for the dramatic variations in ice cover. Independent studies published in 1976 by B. John Mason of the British Meteorological Office and Max J. Suarez and Isaac M. Held at the Geophysical Fluid Dynamics Laboratory concluded that they were indeed sufficient. That put the imprimatur of meteorological expertise on the astronomical hypothesis.

Though two other important questions remain about the pattern of past ice ages, plausible answers may now be given to both of them. The first question has nothing directly to do with the Milankovitch theory; namely, why do we have ice ages at all? For most of the Earth's long history ice has been a rarity. Every few hundred million years, though, episodes of ice-sheet formation occur. Of the earlier periods, one occurring around 270 million years ago is best known. Rocks of that age in South America, South Africa and India show evidence of widespread glaciation. The latest ice epoch started in earnest about two million years back, but was preceded by a long period of gradual cooling, when occasional ice began to appear in Antarctica and Alaska.

These mysterious features of the Earth's climatic personality cleared up with the confirmation of continental drift (SMITHSONIAN, January and February 1975). As continents move about the globe they sometimes pass over the poles and when they do so they tend to ice up. In the earlier glaciation of 270 million years past, South America, South Africa and India were all nestled together in the supercontinent of Gondwanaland, sprawling across the south polar region. Eventually the whole mass shifted northward. Our own series of glacial episodes was potentiated when Australia broke away and left Antarctica in chilly isolation at the South Pole, allowing oceanic currents and winds to develop which encouraged the accumulation of ice. The thrusting up of the Himalayas as India and Asia collided, and of the Alps when Italy rammed into Switzerland, may have helped by creating further pools of cold. Meanwhile the North Atlantic Ocean was opening, providing a potential source of water to make snow, while North America, Greenland and Eurasia were stationing themselves around the Arctic periphery as great platforms ready to accumulate snow and thus create ice sheets.

### *Short-term changes unexplained*

The second and trickier unsolved question concerns the dominance of the 100,000-year cycle, wherein the deepest glaciations occur at times when the Earth's orbit is least elliptical. Suppose for a moment the Earth's orbit were always circular. Then the natural climate of the Earth in the present geological period would be permanent deep glaciation, though temporary relief would be generated by the other two cycles which occasionally concentrate summer sunshine in the colder areas.

It should be noted that the behavior of the planet in response to a given flux of insolation is nonlinear; that is, a change in radiation intensity does not always produce the same cooling or warming effect. The exact consequences will depend upon intricate permutations of the wobble and tilt of the Earth's axis interacting with the orbital parameter, and upon the fact that it takes more energy to freeze water than to melt ice. In recent work along these lines Imbrie and his son John Z. Imbrie, have achieved an excellent theoretical fit with the empirical record of the most recent ice age. Their calculations clearly show a plunge

Artist's conception of the next glacier rumbling down through Manhattan must not be regarded as a near-term solution to the urban-renewal problem. Site may be abandoned well before ice arrives.

to a period of deepest cold about 17,000 years ago, associated with minimal eccentricity in the Earth's orbit. But further back in time our understanding of the 100,000-year cycle falters, and there are still inconsistencies to clear up.

Because of its quantitative rigor, the Milankovitch theory lends itself well to predicting the broad features of the coming ice age. There is no doubt about the general trend. After climbing out of the freezer about 10,000 years ago, the Earth went through a "climatic optimum" about 3,000 to 4,000 B.C. and then began its descent into the next glaciation. Superimposed on that downward trend there has been an alternation of "little ice ages" and short-term "altithermal" intervals, not reflected in the Milankovitch calculations and presumably due to some other cause.

But if nature takes its course, we must expect a deteriorating climate and much colder world for the next 60,000 or perhaps 120,000 years. Such an experience, if it occurs, will be no novelty for our species. Indeed, the drastic fluctuations in climate associated with ice ages markedly influenced the evolution of our ancestors during the past few million years, perhaps especially in the late Paleolithic.

People all over the world have been suffering in recent years from well-publicized spells of "peculiar" weather that bring unusually bitter winters or withering summers, devastating floods or stifling droughts, unseasonable frosts or prolonged January heat waves. These phenomena are not to be regarded as harbingers of either another ice age or of permanent planetary warming. One interpretation is that the world's weather machine has been running more coolly and sluggishly in the past two decades, compared with its more resilient and generally benign character in the late 1930s, 1940s and early 1950s. Nowadays the weather—cold or hot—tends to persist once it is in place. So far, however, the weather has not exceeded the range of conditions typical of the past 1,000 years or so, which included one of the "little ice ages." Curiously, the small fluctuations in climate from century to century are now more difficult to explain than the ice ages proper. One hypothesis is that the sun itself may vary slightly in energy output.

The immediate danger of a cooling trend, according to the National Academy of Sciences, would be changes in patterns of rainfall and mean temperature in areas committed to agricultural use, fluctuations in the frost content of Canadian and Siberian soils and a shift in marithermal gradients affecting the productivity of the fisheries which provide ten percent of the world's protein. A reduction in world food supplies by only one percent means slow starvation for 40 million people, rampant inflation in marginal economies, further slow-

Within a century or so, carbon dioxide buildup from combustion of fossil fuels could result in a melting, in part, of the Greenland and Antarctic ice caps. Ocean levels might rise by 30 to 300 feet.

ing of advances in the quality of consumption, deleterious effects on nutritional standards, trade imbalances for nations accustomed to pay for oil imports with grain exports, and a further aggravation of the already profound social and economic differences between developed and developing states. A world as closely knit as ours today could ill afford such destabilizing effects, and yet they pale beside the consequences of even greater—and quite possible—reductions in food supply. Scientists have pointed out again and again in recent years that the benign climate and relatively predictable precipitation of the last generation are highly atypical of the long run, and that a world agricultural system built upon unjustified assumptions about endless petroleum reserves, cheap fertilizers and good weather is vulnerable to collapse when conditions change. Faced with possibilities like these, and considering the inevitable time lag between perception of a problem and doing something about it, the average citizen might feel disposed to demand of his government that all possible steps be taken to heat the Earth up a little at this time. By sheer inadvertence, in fact, that is already being done—or, some think, perhaps overdone.

There is a growing conviction among meteorologists and climatologists that the short-term danger is overheating, that during the next century or two the Earth will be thermally overloaded by human action. The amount of carbon dioxide in the atmosphere has risen ten percent in the last 100 years or so, and goes on rising as a result of the combustion of coal, oil and gas and the savage cutting of forests worldwide. Physics tells us that carbon dioxide warms the Earth by acting like a greenhouse window, letting photons of sunlight in but blocking the subsequent release of infrared radiation back into space. The excess carbon dioxide might reverse any recent cooling trend. So-called anthropogenic heating arouses further concern: the heat released into the atmosphere and the oceans by nuclear and conventional power generation, industrial activity and vast urban regions may also make a significant impact on the planetary environment in the 21st century. Local effects already have become noticeable. Cities typically create thermal islands which are known to alter eolian convection and precipitation patterns downwind.

To get some notion of what a warmer world might be like, William W. Kellogg of the National Center for Atmospheric Research examined the climatic profile of the Earth 5,000 years ago, when global temperatures were two to four degrees C (up to about nine degrees F) warmer than they are now. The subtropical desert areas of today supported more vegetation then; rainfall was heavier in Mexico, North and East Africa, the

Middle East, India and China. The growing season in the temperate zones was more than a week longer than it is now, and Alaska and most of Europe were wetter too. So far so good, but the North American heartland, the world's breadbasket, was drier; likewise Scandinavia. So whether a general rise in temperature will be welcome depends rather pronouncedly on where you live and what you eat.

If the carbon dioxide threat is real, the natural trend toward another ice age can be averted for a couple of centuries by simply consuming what is left of our fossil fuels. When they run out perhaps "Milankovitch will have his due," as John Imbrie put it to me. Yet, if we develop new sources of energy the crunch might be postponed indefinitely. Space engineers, never at a loss for exotic ideas, have proposed placing huge mirrors in orbit to reflect additional sunlight onto snowfields.

One can imagine a future world government trying to regulate the Earth's heat budget by carefully timed releases of carbon dioxide to warm the atmosphere and particulates to cool it. One snag in trying to set the global thermostat and keep an immense weather machine under human control is that the elements of the system are so slow to respond. For example, George Denton of the University of Maine suspects that Antarctica has not yet fully adjusted to the higher temperatures of the climatic optimum six millenia back. If so, even maintaining present temperatures indefinitely will cause further melting of the ice cap and flooding of many coastal plains. If scientists tried to accelerate natural feedback processes they might drastically overshoot the mark and perpetrate a disaster: total freezing of the Earth into a ball of ice or the runaway greenhouse effect which may have overtaken our sister planet Venus. Climatological engineers would need good nerves, not to speak of a firm political base, for their fateful operations.

Nevertheless, keeping in mind the fecundity of science, there seems a reasonably good chance that we will be technically capable, by one means or another, of making good the shortfall in solar energy during the northern summer and obstructing the march of the glaciers. Whether we should do so is another question entirely. The denizens of the tropical third world may not necessarily agree to drastic and concerted global action to save the North from obliteration. And even some temperate zoners may be willing, as a matter of civic sacrifice, to put aside their surfboards and put on snowshoes for 60,000 years or so.

After the big freeze, retreating glaciers leave their signatures on land in the form of *cirques,* and Neolithic Man evolved from his cold progenitors.

Like a pair of giant exclamation points, the quarter-mile-high towers of the World Trade Center punctuate Lower Manhattan's evening skyline for commuters on the Staten Island Ferry.

*By Russell Lynes*

# The architect was told '*world* trade' so he planned big

*Eight hundred international organizations now occupy the controversial Center's 16 acres; here, a cultural observer casts a favorable vote*

It is seven years now since the first tenants moved into New York's soaring, two-towered World Trade Center (WTC), time enough, so to speak, to get an idea of how it has settled in. There has been, of course, controversy from the day the project was first announced until right now (although, it must be said, on a decreasing scale). Among its critics were those who condemned the gargantuan structures for their dehumanizing effect on the area. Now, in answer at least to this point of objection, there is a new plaza—five acres of open space, at its heart a commanding fountain, a wide circle of polished dark brown granite. The tremendous ball of bronze (cover), a hazel iris at the fountain's center, is set to make one full turn an hour.

The function of the plaza, according to WTC chief architect Minoru Yamasaki, is a humane one, and it exists to afford respite for the urban spirit from the torments of hurry and crowding, a place of relaxation and casualness, a refuge. "Lower Manhattan is a tangle of narrow streets," he said as we looked west from the plaza on a windy March morning. "People can't help but jostle other people. They push each other off the sidewalks into the streets. What I wanted to do was to give them a paved garden, like San Marco, where they can spend a little time away from traffic, a place totally for pedestrians. Some of them have to get away from the tensions of their jobs, some from the monotony."

The analogy with Venice's Piazza San Marco is farfetched physically and spiritually but not in intent. If San Marco is, as Napoleon called it, "the grandest

*Photographs by Marvin E. Newman*

Flags, uniforms, a brass band and a dwarfed crowd marked dedication ceremony for plaza section.

Revolving doors spin shoppers, workers into lobby of North Tower building

drawing room in Europe," the plaza at the World Trade Center may be the most awesome conversation pit anywhere. It is not quite as enclosed as it will eventually be when an 800-room hotel unfortunately will cut across the space between the towers, blocking the view of the harbor, but it has the sense of being what it is for the sake of people, not esthetics—the interplay of the personal and the monumental.

"The genius of the plan," an architect said to me, "is that Yamasaki decided on two tall and slender towers and not on one massive one, so that there is airiness rather than brutality about the open space."

The structure of the towers, each rising 1,350 feet, is unlike that of most skyscrapers. The exterior walls are not "curtains" hung on a steel cage. They are the supports that hold the buildings up and make them rigid. The steel columns, sheathed in aluminum and looking like silver ribbons that flow upward from the pointed arches at the base of the towers, are in fact cantilevered up from the foundations. They form a truss which braces the buildings against strong winds on high. Together with the spandrels they constitute a sort of rectangular tube to which the open floors of the structure are attached. Unlike the cage construction with its structural interruptions of interior spaces, Yamasaki's supporting walls allow for far greater flexibility in how the interiors can be arranged and the whims of tenants met.

When Yamasaki, a native of Seattle whose offices are in suburban Detroit and whose elegant pavilions of commerce, transportation and learning are spread across the world (his biggest job at the moment is an airport for Saudi Arabia), received a letter from the Port Authority of New York and New Jersey in 1962, he thought there had been a mistake. It asked if he would be interested in developing a scheme for a projected World Trade Center and mentioned that what

*Mr. Lynes, a cultural commentator, explored the Cooper-Hewitt in* SMITHSONIAN, *November 1977.*

from fringes of the huge concourse that sprawls beneath the Center.

Feasting at Windows on the World restaurant is for the eyes as well as the taste buds—on a clear day.

they had in mind would be about a $280 million undertaking for construction alone. "My first reaction," he says, "was that an extra zero had been added. My colleagues didn't believe it either, so I called Richard Sullivan who signed the letter and asked him if it meant what it said. He said it did." Fifteen years later the cost had risen to over $900 million, including relocation, demolition and site preparation. There are now roughly 35,000 persons employed in the complex, which is five buildings in all—the two towers, the U.S. Customhouse and two additional nine-story business structures that wall off the plaza. It is estimated that 80,000 visitors come each day on business to see people who work at the Center. In addition to these are the sightseers who come to gape up at and down from the towers, still others who come to the restaurants and cafeterias and those who sit by the fountain in the plaza and eat out of paper bags. Some come to shop in the vast concourse beneath the plaza for flowers or books, groceries or clothes or anything else one expects to find in a sophisticated shopping mall. Others in the late afternoon come to the jazz and marching band concerts and other entertainments in the plaza, or pause there on their way home from work via the WTC rapid transit connections. These visitors add at least several thousand a day.

To talk with anyone who works for, not just at, the World Trade Center is to be showered with statistics. Depending on your temperament, it's either "Gee whiz!" or "God help us!"—disbelief or dismay. One is not likely to be indifferent, not, in any case, in the long shadows of the edifice itself. To wit: every night 600 women with dusters and sweepers move in to clean up the day's mess, and they are complemented by 400 men for the heavy work. A police force of 38 uniformed men keep their eyes and ears open 24 hours a day every day. These are in addition to at least 200 private security guards. The restaurants, about a dozen of them, serve 20,000 meals a day. There are 102 automatic elevators per tower. It takes 58 seconds in the

express elevator to get to the observation deck at the top of the South Tower or the Windows on the World restaurant at the top of the North Tower. It makes your ears pop. It is comparable to Rockefeller Center, for it is not just a piece of architecture, it is, like it or not, a place.

Beatrice Lillie is said to have asked when she boarded the RMS *Queen Elizabeth* some years ago, "When does this place get to England?" The analogy of the World Trade Center with a vast ship tied to the land seems to me more accurate than its comparison with a small city. It is self-contained; it has no sprawl, at least not yet. Curiously, no one in this place which is dedicated to maritime concerns, surrounded by the waters of the harbor and suckled by freighters, mentioned its likeness to a great ship. Its first-class tenants occupy its uppermost floors and eat in its loftiest restaurants. Its crew is "below" in its engine rooms (its refrigerator plant must be the largest in the world). Its crow's nest is the observation deck on the top of the South Tower; its promenade is the plaza. If it should float down the harbor and out to sea, some of its critics would be pleased, but its friends would understand.

It is what its name says it is, a center for world trade. A glance at its tenants' directory confirms this: import-export firms, shipping companies, freight forwarders, customhouse brokers, cargo inspectors, marine insurance brokers, international bankers, steamship agents. There are offices promoting the ports of Seattle, Boston, Baton Rouge and others. There is a World Trade Institute that "offers courses, meetings and seminars on all aspects of international trade for all levels of management."

The tenants have different reasons for how far up in the twin Towers of Babel with their "confusion of tongues" they want their offices. An official at the World Trade Department of the Port Authority said:

Bright-coated floor brokers (shirt-sleeves are taboo) huddle at trading ring to buy, sell with "open outcry" everything from butter to zinc on world's largest trading floor in Commodities Exchange Center.

Miró tapestry brings brilliance and a Spanish accent; windows have been criticized as too delicate.

Concourse is a boulevard linking WTC buildings, the shopping mall and rapid transit systems.

*Guiding Red* by Helen Frankenthaler blends with sun patterns for cathedral mood in the South Tower.

"One Japanese company hired a soothsayer to throw dice to determine what floor they should have their offices on. They wound up in the nineties." There is more cachet to higher than lower and somewhat less convenience. Getting from building to building and access to the shopping and eating concourse is quicker from the lower floors. To get to the upper offices one changes from an express to a local elevator at one of the "skylobbies" (one on the 44th and one on the 78th floor) where there are restaurants, beauty parlors, a smoke shop and banks. The views of the harbor and its surroundings, which include a good deal of New Jersey as well as New York's five boroughs, are of course best seen aloft, from where the Statue of Liberty looks the size of a desk ornament. The top offices are not infrequently above the clouds, like an airplane that got stuck, and there is no telling short of a phone call or a wet visitor if it is raining below.

The critical reception of the World Trade Center has been by no means all enthusiastic. It has drawn a hail of arrows, some of them with flattering bouquets attached to their shafts. It has been called "kitsch" architecture by a critic who praises the Chrysler Building, perhaps unmindful that the generation of critics before his thought *it* unspeakably vulgar. It has been scored by pundits who say that the skyscraper is doomed, the very same critics who deplore the death of the center of cities because of sprawl and no open space for human dalliance. There are critics who deplore what they call the "daintiness" of Yamasaki's arches and the delicate quality of his detailing, to which Yamasaki replies by quoting Emerson: "The line of beauty is the result of perfect economy." To be sure, the arch has an almost timeless respectability both for its structural economy and as a line of beauty. The Bauhaus and its "functionalists" gave it a bad name for 30 or so years, but in the last few, less didactic decades the arch has been reemerging.

A building that everyone likes does not exist unless it has been standing for a very long while and has become part of everyone's visual vocabulary. A landmark building is architecture encased in time and sentiment and, with luck, style. A contemporary building that the public likes and the critics do not has at least an equal chance of survival with one the critics and dilettantes like and the public does not—I'd say a better chance. If that is so, I'll place my chips on the World Trade Center.

As someone said to me, "We know that the WTC is there for sure because somebody had to climb it!"

An escalator carries Jersey-bound commuters and their newspapers to tube beneath the Hudson.

# OPERATION DOUBLE IN THE SOUTH.

Once written off as nearly extinct, the forests of the American South have staged an amazing comeback.

As a result, economists who only a few years ago predicted a world shortage of wood and wood fiber, now see hope of supply keeping pace with demand within a generation—thanks to the almost legendary resilience of the Southern pine and the ingenuity of the forest industry.

This forest has risen like a phoenix on land that had been ravaged by fire, cleared for farms and heavily cut. It was a combination that virtually destroyed the productivity of the Southern forest by the 1930s.

In the context of the times, this was seen as no great loss. The forests seemed endless back then. And there were no incentives to replant since there were no pressing demands for wood products.

Today it's a far different story. There's a new generation of trees, nurtured and cared for by a new generation of foresters. They've helped give the South a forest twice as productive as any before it. A forest of fast-growing pines and valuable hardwoods.

These are the trees that will help fill the nation's woodbasket, thanks to the efforts of an idea the forest products industry calls Operation Double Tree.

An ideal climate has made the South the nation's proving ground for modern forest research.

## An Ideal Climate.

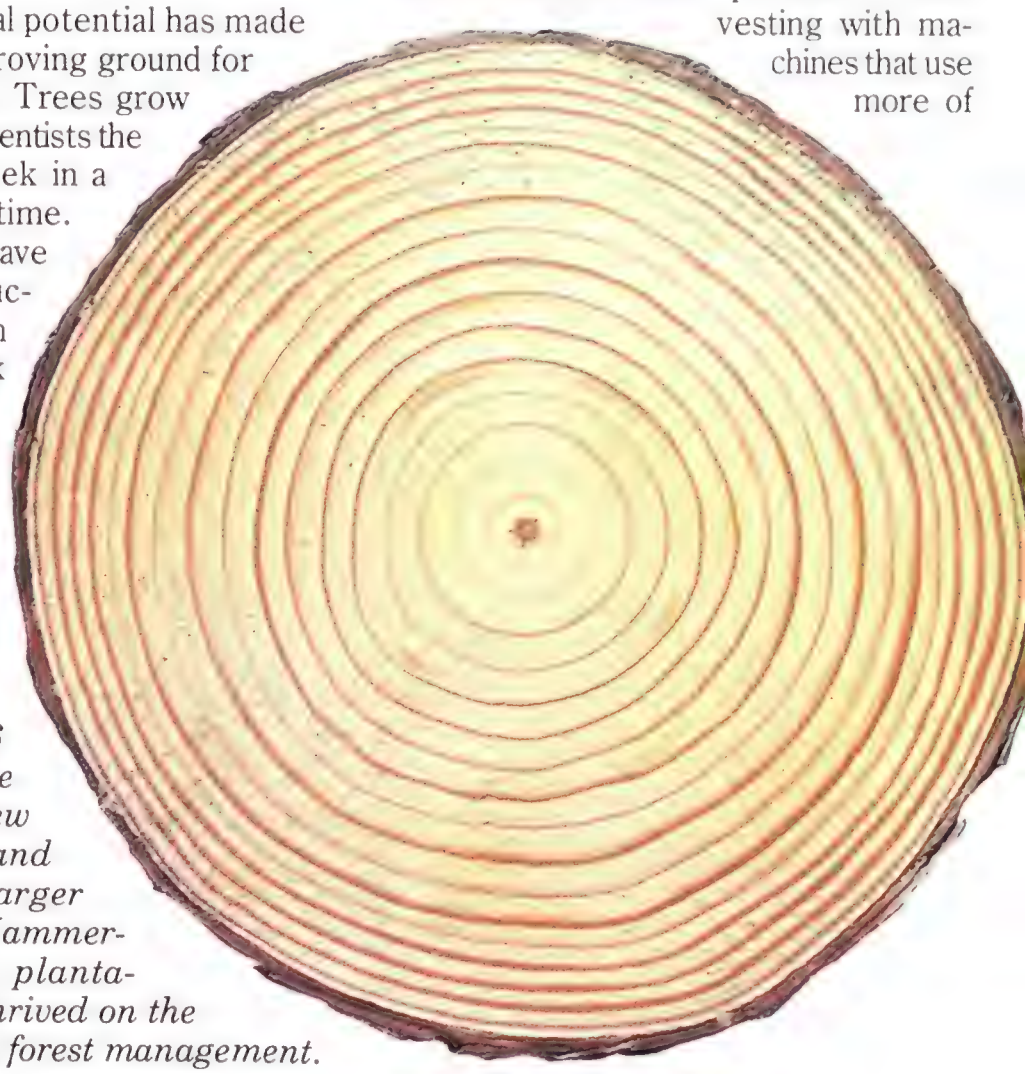
The South has some of the most productive forestland on the North American continent. The climate is moist and warm, ideal for growing trees ten months out of the year.

This natural potential has made the South the proving ground for forest research. Trees grow quickly, giving scientists the results they seek in a short period of time. Techniques that have proven most successful have been modified to work in other parts of the country.

So the South has truly pioneered the way to grow better trees, faster.

On its working Tree Farm® near Jesup, Georgia, ITT Rayonier is testing various methods of planting and fertilizing on trees it's raising for harvest. Now, the trees that were planted a decade ago are already beginning to show which agricultural methods work best on crops of pines.

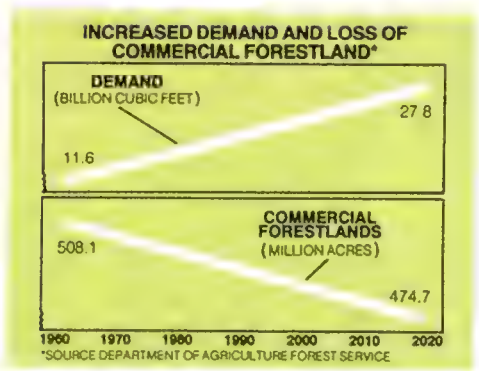
Companies like International Paper, Westvaco, Bowater, Union Camp and Kirby Lumber have also found ways to make their lands more productive. Harvesting with machines that use more of



*The two loblolly pines to the right are shown 85 percent of actual size. Both are 16 years old. The smaller one grew in a natural stand of trees. The larger one grew on a Hammermill Company plantation, where it thrived on the benefits of good forest management.*

### Operation Double Tree: Why it's needed and how it works.

While the world demand for wood is *increasing*, the amount of productive land available for growing trees for harvest is *shrinking*.




In the U.S. alone, the demand for wood and paper products is expected to double in less than 50 years.

Thus the reason behind Operation Double Tree—the forest industry's name for intensive forest management that can double the amount of wood from the nation's productive forestland. And do it in such a way that everyone can share in the multiple benefits of the forest.

# TREE IS WORKING

Southern foresters are growing trees like crops.

every tree. Replanting as soon as possible with fast-growing seedlings that resist disease. And improving stands of valuable hardwoods.

**Sharing The Benefits.**

The companies not only share their knowledge with each other, but also with private landowners as well.

The American Tree Farm System®, managed for the industry by the American Forest Institute, is encouraging some 34,000 landowners nationwide to enjoy the multiple benefits of the forest through good forest management.

The Tree Farm program is particularly important in the South, where two-thirds of the nation's tree farmers live. In fact, individuals already own more than 70 percent of the South's commercial forestland.*

Many of the tree farmers are urbanites. Robert Kennedy is a New York business executive who took over 1,200 acres of unproductive land in Virginia and transformed it into thriving forestland. He put in a lot of hard work. And a lot of time. But it paid off. Today his Tree Farm is a good source of wood, a favorite recreation area, and—perhaps most important—an investment in the future.

**A Long Way To Go.**

So there's progress with Operation Double Tree in the South, and in forests all across the country. But we still have a long way to go. On the average, industry lands grow 50 percent more wood than the lands owned by government and private individuals. Yet, even here, there's room for improvement.

The forest is a resource for all to share.

Overall, the American forest is only half as productive as it could be. And this low productivity is a waste of one of our most valuable natural resources. But working together, all timber growers—private owners, industry and government—can learn to make the most productive use of our remaining commercial forests.

Industry has invested millions to make the concept a reality. But money isn't enough.

Leaders and landowners alike must understand the problem. And, more important, the solution.

For more information, write for our free booklet, "Managing the Great American Forest", American Forest Institute, P.O. Box 873, Springfield, VA 22150.

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®*American Tree Farm System and Tree Farm are registered trademarks of the American Forest Institute.*

**Commercial forest is that portion of the total forest which is capable of, and available for, growing trees for harvest. Parks, wilderness and primitive areas are not included.*

**Trees. The Renewable Resource.**

Suspended from a helicopter, Pheena, a 50-foot model finback whale, floats above boats and below gulls of a marina in San Francisco on way to a first public showing. Larger versions will be cut in half.

*By Matt Herron*

# *Leviathan model brings us the whale we could never see*

*An artist's research into these mammals reveals, among other things, that they are more streamlined than was supposed*

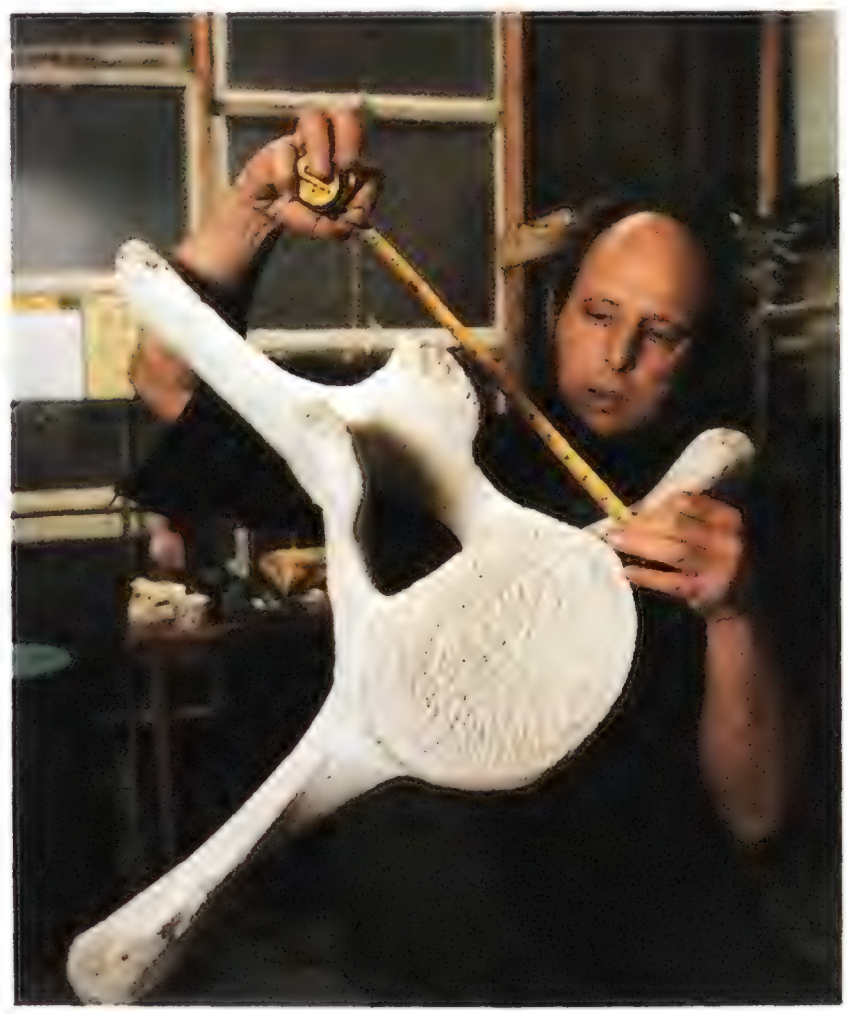
Pheena, the flying finback whale, swims in the breeze, floats over trees, chases seagulls, capers with kites. When she comes down, no child approaches at a walk. Pheena's a sight to run to, a whale for play. Her back's for climbing, her fin for reclining, her rostrum for rows of scruffy knees. She's the only whale of her kind—50 feet long and a ton of fiber glass and steel. That's featherweight by whale standards, so the stork brought her—half a mile across San Francisco's windy bay—teasing the tops of masts, stealing all eyes, then nestling down among the children on Marina Green. Easy if the stork's a helicopter.

Now Pheena lies in the grass and the children swarm all over her. Why shouldn't they? They've never seen a finback whale (*Balaenoptera physalus*) before. For that matter, who has? To see a whale swimming free in the ocean is an awesome sight, but even those few fortunate enough to meet one in the flesh see only the black hump of the mammal. They don't know whales either.

That's the opinion of Larry Foster, Pheena's creator. Larry, a former art teacher who is 43 and lives in Oakland, California, has spent the past seven years in creating lifelike drawings and life-size sculptures of whales. He persists in this singular pastime partly to satisfy a lifelong curiosity about these strange creatures from ocean space, but also to dignify whales, to familiarize their images and to arouse public concern for their preservation. In the process, he has made a unique contribution to the study of marine mammals.

The corporate structure through which Larry's productions flow is known as General Whale. "We call ourselves General Whale because we're the General Motors of whales," Larry explains. "They make the motors; we make the whales." While General Whale has yet to achieve either the volume or eminence of the Detroit corporation, it has not been exactly idle. GW's first life-size production, a 45-foot, ferroconcrete California gray whale, took about four years to develop. Naturally there were problems. In the beginning, General Whale had neither money nor foundation support. Larry supported himself by selling drawings of whales; his dedicated associate, Valerie Cross, supported "Sandy," as they named their cement protégé, with a nine-to-five job. When either of them accumulated as much as $50, they went out and bought more steel. But before they could make real progress they had to know what a gray whale looked like, and this proved a more formidable obstacle than all their monetary problems.

In 1968 very little was known about the morphology of whales, four centuries of large-scale whaling notwithstanding. Valerie came home from her first day of library research to report there were virtually *no* photographs of living whales—only pictures of bloated corpses. Indeed, at that time hardly anyone had photo-



Artist Larry Foster, Pheena's creator, checks the dimensions of a whale vertebra in his studio.

graphed a living whale underwater. Drawings were also rare, and those they found looked distorted.

"When we realized we'd have to work entirely from carcasses, we knew we were really up against it," Larry recalls. "It was like trying to reconstruct an exact model of a '77 Chrysler Cordoba without ever seeing one, working only from pictures of wrecks.

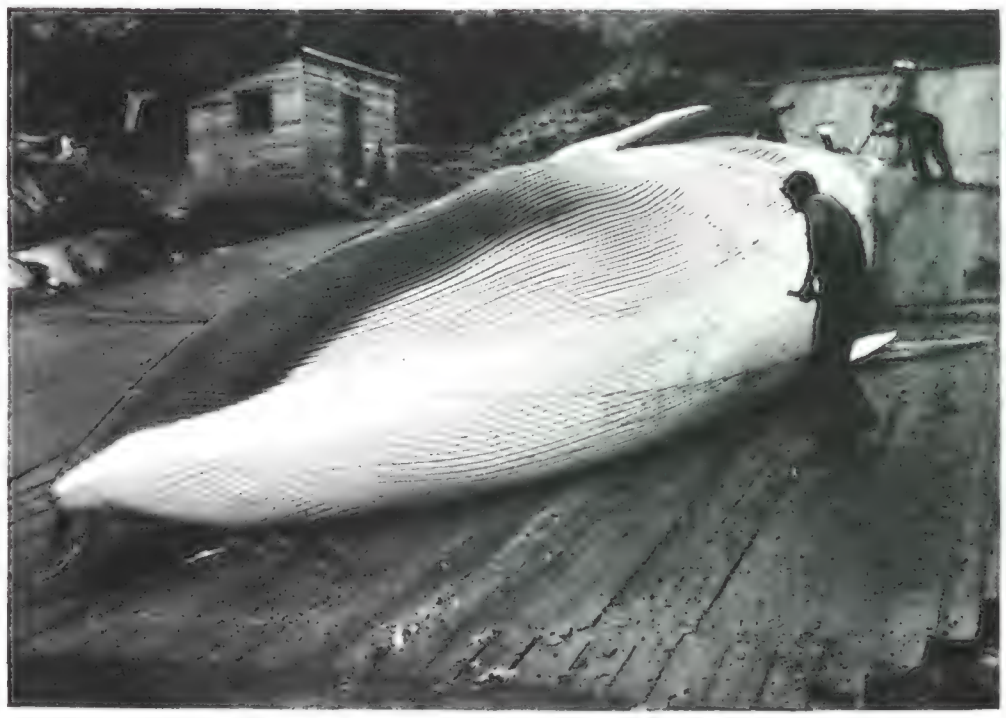
Beginning with the accident victims, Larry and Valerie began collecting whale books and photographs to inform their rapidly changing opinion of what the animals looked like. Materials came from diverse and sometimes bizarre sources. When a branch of the Fremont Public Library burned down, Valerie salvaged all the books on whales. Some were charred, some still smelled of the fire, but they became the nub of a growing library. They wrote for help to every researcher and scientific institution they could find, but few replied. Possibly they had been presumptuous; certainly General Whale was then entirely unknown, and Larry's reputation as an artist was confined to the small following of his stained-glass sculpture.

Undaunted, they began attending the cetological conventions and symposia, appearing at all the cocktail parties, shaking all the hands, pressing their case. Dr. Ted Walker, then of the Scripps Institute of Oceanography, gave them their first significant welcome. "I wrote him a long letter," Larry acknowledges, and Walker, one of the world's authorities on the California gray whale, opened his treasure house to them—a roomful of gray whale photographs and transparencies. They flew down to San Diego, stayed with Walker and copied everything they could use.

At the University of California, Berkeley, Valerie

*Matt Herron is no stranger to whales himself. In August 1976 he described the efforts to disrupt commercial whaling in the Pacific.*

A rare photograph of living whale underwater by a biologist reveals a more streamlined shape



In a historic photograph from the Smithsonian, flensers study blue whale caught off Newfoundland.

than had been thought. This specimen was caught with nonexplosive harpoon (behind left fin).

began going through the files of the biology laboratory—a three-year project, as it turned out. She also uncovered an English translation of A. G. Tomilin's massive work, *Mammals of the USSR and Adjacent Countries.* Together with the *Norwegian Whaling Gazette,* Tomilin's volume on cetacea provided a kind of statistical backbone for their research, listing measurements of all Americans, Russian and Norwegian whaling kills for all the years that modern whaling has been carried on. By averaging hundreds of measurements, they could verify and refine the evidence of their growing picture files—determine the precise shape of a fluke, the exact location of a fin, the discrete folding of an eyelid.

On a trip East, Larry and Valerie met Dr. James Mead, associate curator of marine mammals at the Smithsonian Institution. Buried in the Institution's archives, Mead told them, were old and rare photographs of harpooned blue whales—Frederick W. True's record of Newfoundland whaling at the turn of the century (opposite, bottom). Unfortunately, they were uncatalogued, and the blues were indiscriminately mixed with pictures of sperms, minkes, fins, humpbacks and others. Impressed with their knowledge of cetaceans, Mead struck a deal. If Larry and Valerie would help catalog the collection, they could have copies of anything they wanted. They flew home with 60 precious glossy prints—the best of True's work.

And then, as if stumbling into the promised land, Larry came upon photographs of whales alive in the water. In 1970, Gordon Williamson, a Scottish fisheries biologist with ten years of experience in cetacean research, had persuaded some Japanese whalers to use

Foster's drawing of a blue with divers is more than nine feet long. An outline copy is in Smithsonian next to a life-size model, with a statement that the drawing indicates the true shape more accurately.

Jack Sims and Clark Permar shape and weld the steel framework that will give Pheena her final shape.

nonexploding harpoons, which do their job more slowly. Williamson went over the side of the whaling ship and photographed the tethered and dying animals still swimming underwater (pp. 54-55).

These melancholy photographs were a revelation. They confirmed what Larry's research had already led him to suspect: that rorquals, a genus of baleen whales that includes blues, fins, seis and minkes, do not look at all like Goodyear blimps. Despite their great bulk, they are in fact unusually streamlined and sleek animals—more adapted for fast swimming than for presenting prodigious advertising surfaces to the ocean. The virtually universal misconception of their shape stems from the gross distortion rorquals undergo when hauled from the water onto a beach or flensing deck. Their tremendous bulk, and especially their belly pleats—those vast accordions of enfolded skin that can increase the capacity of a plankton-filled mouth by 20 times—splay out over a hard surface until it is practically impossible to know what the animal might have looked like.

All this information was taking root and spreading out in Larry's mind; very early this undergrowth began sending up shoots in the form of remarkable drawings. Tentative at first, these whale renderings began as learning exercises. Larry, the artist, could ponder research reports all he wished; the knowledge became his only when he touched a drawing implement to paper. He chose the most tedious and uncompromising of artist's tools—the drawing pencil, needle-sharp and applied always at its finest point, never as a shading implement. Used in this manner, the pencil becomes an instrument of exploration. "I really found out what I knew and didn't know, using that pencil," Larry recalls.

Many of the drawings opened new ground, revealed new relationships and shapes; Larry was working out problems that had not been solved before. How far below the mouth and eyes is the flipper of a blue whale? How curved the dorsal of a minke? The answers were drawn, laboriously, from the research library. Sometimes there were no answers. "There are 20,000 sperm whales killed every year," Larry laments. "Twenty thousand. Yet I still don't have a clear idea of where the eye is. How can you do someone's portrait if you don't know where to put the eye?"

The renderings went to scientists. With the expanded audience, Larry's reputation as a serious researcher began to grow. These men, many of whom had spent a lifetime studying the behavior and physiology of whales, seldom had seen cetacean anatomy through the informed eye of an artist. Some found reason in the drawings to alter their thinking. Dr. Ken Norris, of the University of California, Santa Cruz, is the editor of a standard work, *Dolphins, Porpoises and Whales*. Norris first saw the drawings at a conference on the gray whale in 1974. He pored over Larry's portraits of a finback and a blue and, during his talk that afternoon, credited Larry with making thermal regulation among rorquals understandable for the first time. "All previous conceptions have pic-

Inside whale model, details of construction can be seen. Ribbed structure of fiber glass substrata is visible.

tured rorquals as obese critters, with a surface area too small in relation to their actual volume to lose heat efficiently," Norris remarked. "Larry has shown how attenuated they are, and when you study his drawings, it's easy to understand how they balance their thermal budget—more surface area, greater heat loss."

More recently Larry agreed to illustrate a chart of cetaceans for the National Geographic Society with Mead as consultant. At a planning conference, Mead was asked what scientific corroboration existed for the many innovations in Larry's drawings. "If Foster's wrong, who's right?" Mead replied. "He *is* the authority on this subject; he's done more research on the external appearance of large whales than anyone else in the world."

In 1975 Larry laid down his pencil. The whale renderings, 50 in all, had run like a basso continuo through more than five years of his life. He could draw by heart more than 50 of the 80 species, including all the great whales.

Sandy, the first large whale sculpture, lurched toward completion. As Valerie tells the story, Larry announced his plans suddenly one morning: the California Institute of Technology whale symposium would open in three months; they had to have Sandy ready for it. The basic whale already filled the studio, shaped out in welded-steel reinforcing rod. But as any builder of cement boats knows in his aching bones, the really horrendous job in working with ferroconcrete is wiring on the multiple layers of chicken-wire mesh that will trap the concrete to the armature—thousands of individual ties. They held mesh-tying parties. Friends came, and Larry's students; they twisted wire until their eyes crossed.

Sandy was a sensation at Caltech. A few days later the Boston Museum of Science called: could they load the whale on a flatbed truck right away? Sandy went to Boston, all 5,000 pounds of her, to become part of a "Celebration of the Living Whale." The whale did things to people (one morning the museum director's secretary was found sitting quietly on her back), and after Boston she began a two-year migration that covered the Eastern Seaboard, the South and eventually the Midwest before returning to her spawning grounds in time for a whale extravaganza staged by Governor Edmund G. (Jerry) Brown jr. last winter in Sacramento. Why would a governor tout whales? Brown confided to Larry that when he was stumping the state during the Presidential campaign, he noticed more bumper stickers for whales than for Brown.

The governor was right; something akin to a movement was afoot. In classrooms across the nation children were drawing whales. Off the West Coast a small band of Greenpeace commandos were patrolling in an old fishing boat foiling Russian whalers (SMITHSONIAN, August 1976). Everywhere posters and bumper stickers blossomed urging the boycott of Japanese goods until whale killing stopped.

### *A model equal to the subject*

Pictures of whales were appearing everywhere, more and more of them Larry's. It seemed a good time to revive a long-standing ambition, the construction of a really *big* whale—one that would convey in unmistakable terms the awesome scale of the planet's largest creatures. Larry had toyed with doing a 100-foot blue whale, but problems of construction and transport seemed insurmountable. Whales, he firmly believes, should be readily available to people everywhere, and this one would have to travel—from shopping center to shopping center, school to school, museum to museum. A 50-footer, he figured, would be close to the limit that could legally be squeezed onto a tractor and semitrailer—about the size of an adolescent finback. But here the plan grounded on technicalities.

Fiber glass seemed the ideal material for the new whale (no sane man would attempt two ferroconcrete creations in the same lifetime). Fiber glass is light,

relatively inexpensive, and it lends itself readily to curved surfaces. But glass fibers in the raw are also limp. To form any shape, they must be laid over a mold. In effect, to build a whale one must build two—the first a perfect wooden brother to the second. Fine for a fleet of production boats, a 50-foot mold is just too much time, energy and money for a single creation. So the finback foundered until a technical innovation appeared. A boatbuilder in New Orleans had invented a fiber glass with backbone, a sort of springy plank stiffened lengthwise with thin fiber glass rods that would take compound curves over frames, thereby eliminating the need for a mold. Larry enjoys inventive technology, and the material, known as C-Flex, seemed made to his measure.

Whale sculpting is much like custom boatbuilding: the shapes are similar and so are the problems. In boatbuilding one begins with plans, usually line drawings. The lines are painstakingly translated into full-size patterns, a process known as lofting, and riblike structures are cut from the patterns. These frames are positioned along a supporting structure called a strongback. Planks of C-Flex, the length of the boat and a foot wide, are cut from a big roll, laid over the frames and fastened in place. The planks take the shape of the frames and a boat (or whale) begins to emerge.

The plans for Pheena were entirely lodged in Larry's head—he turned out a 50-inch clay and then plaster models in less than a week. Much of the research had been done years ago. What little was needed came straight from the files. Valerie, for example, confirmed the position of Pheena's dorsal fin by averaging from their records the measurements of 800 animals. Then another innovation: the plaster model was sliced into one-inch sections as one would slice a cucumber. Each section was projected whale-size on a wall with an opaque projector—full-size patterns in one easy operation. A friend of Larry, Clark Permar, builds steel fishing boats in this manner.

Larry turned the actual construction over to Jack Sims, one of the eight full-time working partners in General Whale's rapidly expanding empire. With a boatbuilder hired for the job and occasional touches of the welding rod from Clark, Jack brought Pheena to completion in a little less than two months, working days and frequently nights to weld the steel framing, lay on the C-Flex and additional laminations of fiber glass and resin, fill and smooth the body with fairing compound, and apply the finishing layers of pigmented resin. After 2,570 linear feet of steel, 3,000 square feet of layered fiber glass, two and a half barrels of polyester resin, 50 pounds of microsphere fairing compound and 1,900 man hours, Pheena lay dark and gleaming at the door, waiting for the helicopter.

The ceremonies were brief. A bottle of champagne splashed her snout. Walkie-talkie speculation passed between Jack and the pilot. Would Pheena shimmy dangerously in the chopper's downdraft? She didn't. Perfectly balanced, Pheena rose.

Later, among the crowds on the Green, Larry stretched his length on Pheena's nose. He seemed pleased. The whale would begin her journeys soon, underwritten by the World Wildlife Fund. The success with her construction augured well for the projected 100-foot blue, split in two for easy transportation. There are other projects: a General Whale museum for San Francisco with a workshop where visitors could watch whale models under construction; a mass-produced minke whale cheap enough for purchase by small museums; a children's book of whale paintings; a partnership with the World Wildlife Fund which envisions Pheena's children and other models moving around Europe in mobile displays.

Then there is the fascinating problem of motion. Whales, after all, do not lie around. Larry has been studying films of swimming whales. He has his own ideas about cetacean propulsive movements, and has already constructed a prototype machine that imparts realistic swimming motions to a small rubber dolphin. It seems only a matter of time before swimming whales will hang from museum ceilings.

All around him children were taking their first measure of a whale. The interaction suggested that Larry Foster's outlandish vision might not be so outlandish: bring whales to people and people will bring protection to whales.

At Fort Mason National Recreation Area, Foster measures the whale in what would seem to be appropriate units: Pheena is just 12 children long.

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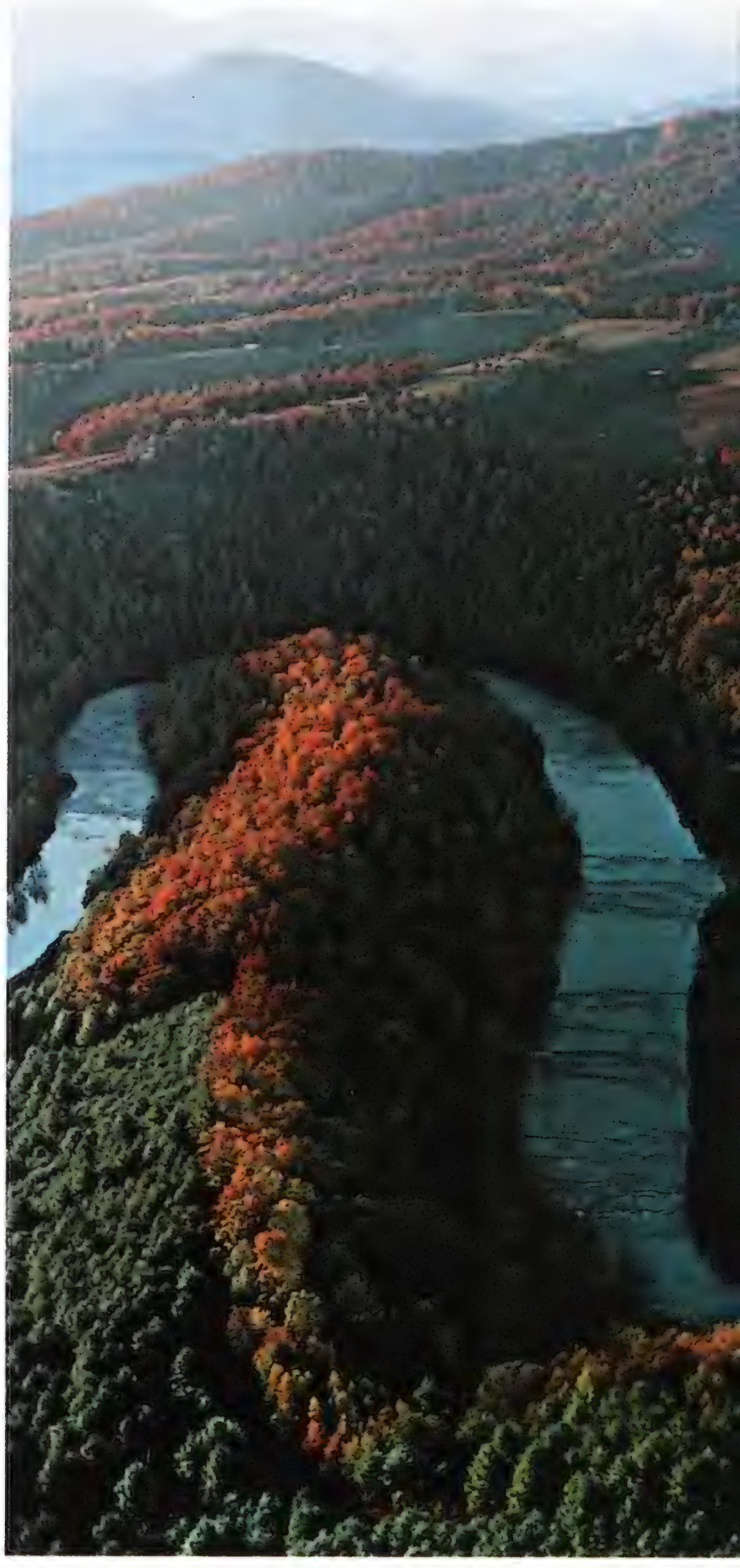

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**NORTH CAROLINA**

*By Benjamin Forgey*

# Art out of nature which is about nothing but nature

*The outdoor work of Michael Singer is delicate but tensile, minutely calibrated, a visual celebration of place and spirit*

The Documenta exhibitions, held every four years in Kassel, West Germany, bring forth as a rule the

To get to Michael Singer's artwork from the main buildings of the Smithsonian Institution's Chesapeake Bay Center for Environmental Studies, where scientists investigate the endangered ecological systems of our estuaries, you had to take a truck for a mile or two along unpaved roads, walk down the hillock to where the canoe was beached, and paddle a short distance upstream, rounding two bends before docking under the overhang of a tree. (Today, a year later, progress up the stream is blocked by a fallen log and the work itself, opposite, is disintegrating.)

It wasn't very far from the Center's offices and labs, not really all that far from the highways and the cities, but it was quiet and private. A few strokes of the

Blended into his work as his work is blended into wherever it is, Singer works with growing things.

most notable work of major international artists, forerunners in many cases of things in art to come. This is Singer's piece at last summer's show, *First Gate Ritual Series*, 16 by 80 feet.

paddle in the brownish waters of the stream, and you were surrounded by thousands of erect cattails rustling softly in the wind, looking almost white against the tawny Spartina grass with its feathery tops. As you rounded a bend, hardwood trees on the higher ground could be seen silhouetted above the grasses.

Several hours before, at a lunchtime gathering of the scientists on the Center's staff, Singer had been trying with a sort of last-ditch eloquence to explain just what it was he had been doing on, for and with—especially with—their turf.

"I'm not out there working to compete with the environment," he had said. "Going to see the piece is to partake of the ritual—discovering the path in the woods, trying to sense the quiet of the marsh, the piece nestled, woven within it."

Woven was the precise word. In a month of solitary labor the artist, trudging around in the muck of the marshland grasses, had built an airy construction some

At Smithsonian Institution's Chesapeake Bay Center for Environmental Studies, at a place where two rivers meet, a Singer piece of marsh materials.

The artist's collage drawings, done on paper with various materials (here charcoal and white and gray chalk), are closely related to Singer's work outdoors, grand views of space and objects within it.

200 feet long and perhaps 70 feet wide, an intricate web of horizontal lines set into the marsh yet subtly distinct from it, like some sort of beautiful but inexplicable natural event.

The path Singer had cut through the woods led to a ridge where he had burrowed out a spot to sit down while contemplating the setting, his structure within it. The view was indeed fine, thought-provoking. Through a break in the trees you looked almost directly north over the broad, flat patch of marsh to another tree-lined ridge. The stream curved from underneath this ridge and continued on west, out of your vision, joined by another stream that slipped into view from the northwest from yet another wide swath of marsh. One could intuitively understand why the artist had picked this site.

From the hillside burrow the whole piece spread itself out before you like a surprise. The horizontal members of the structure (there were 150 lines in it, Singer said) bent this way and that in an unpredictable, though obviously controlled, rhythm, as in a fine drawing. Gradually, as the angle of the western sun decreased, these lines began to catch the light. In retrospect one's impression seems sharp and clear, the piece floating luminously among the softer-colored grass under the dome of the sky. It actually happened, though, by degrees, each change in the light changing everything in the self-contained panorama before you, keeping your senses finely tuned.

Down in the marsh, inside the piece, Singer could hardly contain a grin of sheer joy as he went about checking the jute ties that held his incredible structure together. The piece was made of native marsh materials, 25-foot bamboo poles both as vertical supports and also as tensed horizontals and diagonals, and Phragmites grass tied in bundles. Only from inside it did you begin to sense the true complexity of this drawing-in-space. Putting it together obviously represented long, hard work, but you recalled again what he had told the scientists: "I've felt like a child exploring, enjoying."

"What a way to make a living," he said in a lighter moment, though without any trace of smugness—just pleasure and a certain bemused wonderment. That many of the scientists at the Center had been uneasy about Singer's work is understandable on one level, although on another, still fairly simple, level—that of the self-evident beauty of what he makes—their uneasiness is hard to comprehend.

Singer has worked in a Vermont beaver bog, in the Everglades, in West Germany and, as John Russell put it in a *New York Times* review, in several of the "damper public parks in New York State." During the last two years he has been invited to create indoor pieces for exhibitions in several gallery spaces, including the Art Museum of South Texas, overlooking the Gulf of Mexico in Corpus Christi. Other indoor shows were held at the Smith College Museum of Art, the Neuberger Museum in Purchase, New York, and the Wadsworth Atheneum in Hartford.

Singer's odyssey has more than a touch of the romantic quest about it, though it turns an ironic twist on the standard version. It begins, that is, not with the Artist Rejected but with success. Singer was living the life of a bright, schooled artist in New York, participating in the talk and the all-night drinking of the scene, but working unobtrusively in the studio (a huge space two floors up in a former synagogue near Chinatown) and, quite consciously, not trying to show the work. Through the grapevine of the scene, however, word somehow got out. His studio was duly visited by the uptown curators and his work selected for a new-talent exhibition at the Guggenheim Museum.

Singer's two sculptures for the Guggenheim were big enough that the steel beams for them had to be hoisted through the towering vault of Frank Lloyd Wright's spiraling galleries. Singer, then just 25, recalls that "It scared the hell out of me. I really wasn't ready to show my work in the Guggenheim. I hadn't even had a gallery show." The vision of a pressure-cooker career propelled Singer toward Vermont, where he found himself, much to his surprise, getting up at dawn with the farmers.

There is a certain Thoreauvian charm to the story of city-bred Singer's time in Vermont. All told, he spent three winters there in a rented farmhouse,

*Benjamin Forgey who last wrote about Arttransition at MIT,* (SMITHSONIAN, *March 1976*), *writes about art and architecture for the* Washington Star.

Plate shown smaller than actual size 10¾″ diameter

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ruminating and working. His Walden Pond was a beaver bog and its trees, gnawed through by beavers or felled by some other natural circumstance, were his great discovery.

Singer, at first intrigued and then, perhaps, obsessed, began visiting the frozen bog every day and wondering about those trees. He started to haul them this way and that and soon began to hoist and tie them with the idea, he says, "of getting all those trees to the point where there was a weightless situation"—in other words, to a point of perfect physical and visual equilibrium. The trees of course would sag and fall each year with the greening of the bog, but Singer returned in winter to make something new again.

Singer's art has evolved considerably since that first productive winter in Vermont, though certain attitudes have remained. He works in nature with nature, and seems incurably happy with that. In each habitat, after selecting a specific site, Singer spends a lot of energy and time "psyching out" the place, getting to know its smells, sights, sound and especially its light. As he works he becomes familiar with the movements and private time clocks of the animals and the plants. Making art for Singer becomes a sort of absorption into a place, and this is reflected in the structures he builds, not only in the materials he makes them with but also in the way they are placed in the site, and in their visual presence.

In Hecksher State Park, New York, where he built 14 structures of bamboo and Phragmites dispersed across a marshy field of some 50 acres, to see the whole one had to scan the field, as if on lookout. A storm ripped his structures apart after one week. That was the beginning, he says, of his awareness of the element of time and constant change, and his acceptance of it.

Singer spent two and a half months in the Everglades, working mainly in a large burned-out field

The *Lily Pond Ritual Series,* 1975, Harriman State Park, New York, a horizontal piece of the most

carefully tuned balances, about 80 feet long. To reach it you walked a deer path hidden by high grass.

bordered by a stand of tall pines. Here, he arranged his structures on bamboo tripods across the field in a row, like a series of gates to the clouds. In the Everglades Singer learned to use the sky, to incorporate its moods and resonance into his awareness of his own purposeful activity.

In Harriman State Park, also in New York, Singer constructed a solitary, horizontal piece (called the *Lily Pond Ritual Series*) some 80 feet long in a pond. Here as elsewhere the artist selected a spot from which one could quietly view the structure, in this case attainable only by following a deer path through high grasses. The effect (left), to judge from photographs taken on the spot, was a startling jewellike apparition. Here, too, Singer finely calculated the orientation of his piece so that its "moment of magic" would occur in the late afternoon, only here the magic was doubled by the shimmering reflections in the dark water, which tended to hide the supporting vertical struts so that the glowing horizontal lines seem to hover in the air.

Singer used this effect again in a more recent piece—actually two related units—constructed in a small pond on the spacious grounds of the Nassau County Museum of Fine Arts, Roslyn, New York (pp. 68-69). Although built with narrow struts of wood instead of bamboo and marsh grasses, these pieces also relied upon delicate intersections and finely tuned counterbalancing to make what one critic called Singer's "serene and factual" statement. Last summer he built a similar piece (pp. 62-63) for the Documenta 6 exhibition in Kassel, Germany, the huge, quadrennial get-together of the international avant-garde. Typically, Singer chose a secluded site, far from crowds.

*Emotional interplay of objects*

Most of this work, though supported by the established money-granting institutions in the art world, was inaccessible and transitory, and done away from the eye of the official art world—the critics, curators and artists who make opinion and reputations. The Singer story came full circle, however, in December 1975, when Singer had a show of his work at the Sperone Westwater Fischer Gallery, a high-powered New York dealership with international connections. The response was electric. Critics uniformly praised the beauty of the work—photographs, collage drawings and a piece constructed in the gallery demonstrating the same delicacy and tact as the outdoor works.

The important thing about the response to the show, however, was the recognition that there was something forceful and original going on in Singer's work, not only in the visual and emotional interplay of the objects, but also in the processes—the thinking process and the actual doing of the work.

There are, to be sure, plentiful precedents for making relatively transitory art works out-of-doors in remote locations. Artists for some time have been giving us literal signals that art is not necessarily a finished product confined to the allotted territories of home, the gallery, the museum. But the differences in Singer's work seem as important as the similarities. Singer shares a profoundly romantic urge with "earth artists" such as Michael Heizer or the late Robert Smithson. Singer's work is stylistically worlds apart: nonarchitectonic, calligraphic, using only materials made by nature and employing only preexisting principles of self-contained tension in their construction. Just as important, Singer's messages differ: they are about nature itself, and about Man's relationship with na-

View from a trail at the Nassau County Museum of Fine Arts, Roslyn, New York, 1976, of

ture. Most outdoor sculpture, conventional or otherwise, makes its point, aggressively or tactfully, in contradistinction to the natural setting. Singer's work attempts to coexist with nature, metaphorically and quite literally.

Singer, understandably, dislikes being called an "ecological artist," although author Alan Gussow (who is also a landscape painter) wrote of Singer's work that it is "the perfect embodiment of [an] ecological viewpoint [that] accepts the notion of nature as a complex, life-sustaining process."

Indeed, his work, in a symbolic way, can be seen to have certain practical lessons: the ecological systems of the marshes, threatened almost everywhere by the relentless advance of urban, man-made systems, have a crucial role to play in the continued vitality of much larger environments upon which humankind depends—as, for instance, the whole vulnerable fabric of Chesapeake Bay.

Still, Singer is a better artist than just that. His work, so beautiful and so poetically charged, functions on a much broader metaphorical level than any rudimentary notions of ecology. Part romantic quest, part mystical search, part visual research, his art is capable of saying many things to eye, head and heart. He refers to all of his pieces as "rituals," a meaning that takes in the aspect of time—time spent to look at, to experience, and to recognize not only the subtle manifestations of the art but also the subtle and necessary harmonies of nature itself.

the *First Gate Ritual Series*, a work of oak and rock. The two related units which form the work are only a short distance away from the rush and noise of highways but form another world.

*By Michael Olmert*

# A pope's library is brought to light after 200 years

*At Washington's Catholic University, scholars are cataloguing the rich details of Pope Clement XI's 10,000 rare books*

Clement XI, depicted in appropriately respectful fashion, on a dedicatory page in his library.

The year is 1582. You are a cleric at St. Peter's, Rome. You have just been given a new hymnal, an elegant one produced by the Lyonnais master printer, Robert Granjon. Its rich, dark leather binding, tooled with gold, is soft and pliable in your hands. Inside, its pages leap to your eye and lift your spirit, the result of a confident and crafty use of print and paper. The reds and blacks of the musical notation are perfectly counterbalanced by a sharp and easy-to-read type. It is a joy.

You are now crossing the chancel, under the rapt gaze of the College of Cardinals; a sea of scarlet robes surrounds you. You genuflect, and as you do, a glint of light distracts you. On the floor, a needle—a valuable commodity in the 16th century. You snatch it up, and then . . . what? A safe place would be here on the last blank page of your new book. You skewer the page, and then forget about it—and forgotten it was for 400 years.

Today, that needle and that book (Giovanni Guidetti's *Choir Manual*) have been rediscovered. And they are enshrined with nearly 10,000 other books from the library of Pope Clement XI at Catholic University in Washington, D.C. After 200 years of dusty obscurity, the collection is again receiving the attention of scholars and book lovers. These books are now perceived to be a window on the Renaissance and its intellectual life, as well as a font of details on the early history of books and how they were made.

Gian Francesco Albani, who was unanimously elected and served as Pope Clement XI from 1700 to 1721, was both a scholar and a bibliophile. The books that his family assembled—from the earliest days of printing in the 15th century through the Albani family's most influential period, the 18th century, and on into the 19th—are marvelous to behold.

And well they might be. The family came from the important town of Urbino, which holds a strategic spot along the ancient Flaminian Way, as one travels north from Rome. Clement's grandfather, Orazio Albani, parlayed this political and geographical accident into power by negotiating the treaty that made

From the Pope's library, a display of the binder's art is assembled in all its rich and varied glory.

*Michael Olmert is an Annapolis-based free-lance writer, graphics designer and student of fine printing.*

Several of the books in this imposing shelf of volumes bear on their spines the insignia of the Albani family—the trimount and a star.

Urbino, early in the 17th century, a part of the Papal States. He was made a Roman senator for his pains. Clement's father and uncle were both in the employ of the Barberini pope, Urban VIII. From that start, the family continued to improve its position right through the 18th century, when the list of Albanis numbered one pope, two counts and four cardinals. During all that time they read and collected books, and stored them in their Rome and Urbino villas.

In 1927, the surviving Albani heirs offered a third of the family library to Catholic University. Wisely, the university administration blinked but plunked down the rather paltry $22,000 asking price, and in the process acquired a lode for bibliographic studies and Renaissance history.

The library has works on astronomy, law and science (including a 1720 "science-fiction" novel about a flying ship with oars made of feathers). Also included are

Comfortable in the hand, filled with wise sayings, prose and poetry of Sannazaro, vellum bound.

At bottom of superb paper cover is Clement's shelf mark of the 185th book, second shelf, case D.

Example of the wonder in making books, called goffering—the decorative art in fullest flower.

Pages from a book containing ink doodles belonging to Clement's nephew, Annibale Albani, himself a cardinal. Hand with pointer marks important passage.

books by such major writers as Erasmus, whose name is occasionally obliterated from a title page but whose prose remains, and England's King Henry VIII, represented in the library by *Assertio Septem Sacramentorum Adversus Martin Lutheru* (printed in London, 1521), for which he had been rewarded with the title "Defender of the Faith." John Milton is there—with an Italian translation of *Il Paradiso Perduto,* printed on blue paper.

Cataloguing a 10,000-volume library, spanning four centuries, is no easy task. Work has just begun—with a grant from the National Endowment for the Humanities—on a thorough survey of the books, authors and printing techniques represented in the collection. What has been found so far is impressive: new editions of important works, new works by established authors, even a number of curious works by unknown authors.

Carolyn T. Lee, curator of rare books, is in charge of the project. For her, the challenge is in solving an antique puzzle: "This is essentially the library as it looked in 1721. But the handwritten catalogs from those times give confusing and contradictory shelf marks for many of the books we have. The job is to solve the puzzles and restore the original system."

A great deal is known about how the library worked. One of the few manuscripts in this collection of printed books is an incomplete catalog of the library, written down in 1720. It includes a drawing of several of the bookcases, probably just as they stood in the Albani library. From that, the experts know that each book was assigned to a particular shelf and a particular spot on the shelf. Thus, a book marked "R 16 III" would be the 16th book on the third shelf of case R (Philosophy). The problem is that none of the three beautifully handwritten catalogs that survive is com-

Curvilinear title page, showing second printing (in red) is topped with red cardinal's hat.

A rare, highly worked and yet dignified book cover: leather in variations of red with gold.

De diuina7 etna
Incipit liber de vita Ihu xpi nõ ille de infãtia saluatoris apocriphus: sed ex serie euãgelice historie collectus.
De diuina et eterna xpi generatõe. Ca.I.
E plenitudine itaqz euangelij
.vini.s.boni quod vsqz ad hoc

The initial letter O, a fine shape, containing lots of space for flowering embellishment.

Woodcut, *Democritus Laughs,* illustrates a late 17th-century book relating adventures with a flying machine, its various parts alphabetized.

plete, and all give a welter of conflicting shelf marks.

Then there are the book tags: many Clementine volumes have a tag pasted inside the front cover; it sticks out the top of the book. No one has been able to solve the two-number system found on those tags. A further tantalizing aspect is that the tags are made from paper cannibalized from other books or old manuscripts. Part of the old printing is still there, begging to be read.

But such puzzles are far outweighed by the sheer delight of working among row upon row of creamy vellum and morocco books.

### *The earliest books the best*

Historians of printing refer to the first years of the art as its "cradle" period, and the now-rare books from that time are known as incunabula, cradle books. Gutenberg's first productions date from about 1440 in Mainz, Germany. The simplicity and commercial possibilities of printing with movable type were quickly apparent. In other nations, printers rushed to hang up their shingles, and title pages began to bear the imprint of such cities as Venice, Padua, Antwerp, Paris and Lyons. William Caxton printed the first book in English in 1475. By 1501, the incunable period was at an end and a new age had begun.

The incunabula in the Clementine collection demonstrate that the earliest printed books were among the best ever made. A tract on the alphabet and the origin of Latin words by Giovanni Tortelli (1440-1466), printed in Venice in 1471, is just such a beauty. First off, its paper is soft and textured, and is an off-white; it absorbs light rather than reflecting it. Second, the typeface is a solid Roman one with sharp serifs at the edge of each letter; they guide the eye so that it sees words rather than a run of individual letters. The black ink must be still as crisp as the day the impression was pulled from the press. Third, each new section of the text—the book is arranged like a dictionary—begins with a flourished capital initial letter. But in deference to the commercial appeal of the illuminated manuscript, which was still extant in 1471 (and would remain in demand for at least a century), those initial caps have been painted in: one in blue ink, the next red, alternating down the page.

Italic writing has since become known as the script of humanism, the easiest hand to learn and write, and a delight to see. From its start as the official script of the papal court, it spread all over Europe. The young Elizabeth Tudor was taught it and as queen signed official papers with the familiar thicks and thins of that graceful, flowing hand. In the end, the Tortelli book is an inside look at the transition from the handwritten manuscript to the flowering of print. Hand-

painted initials, black Roman type and an italic script are all unified into a balanced whole.

Other Clementine books show how book owners made their demands known to printers. A 1493 law book, printed in Basel, has elaborately drawn hands in the margin to point out important lines or sections. Those pointing fingers are often long and insistent, and there is a ruff around each wrist. The gloved-hand printer's device, called a gauntlet, which more often today shows the way to rest rooms, thus had its origin in such marginal doodlings.

Another incunable, *The Miracles of St. Jerome,* shows the commercial wisdom of the early printer. Although the printer left a large indentation in the body of his text for the rubricator (who would later add the red initial letters), he also took the precaution of printing a small black letter. This did two things: First, he could use a "discount-house" rubricator who didn't have to know Latin; all that was needed was a red copy of the small black letter. And second, he could sell cheap unrubricated copies of the book that would still be readable; otherwise, the first letter of every chapter or section would be missing.

*A medieval best seller*

One of the most popular of all early books was by Johannes de Sacrobosco (1200-1250), whose astronomical guidebook *Sphaera Opuscula* went through 30 printed editions between 1472 and 1500, even though it was already 250 years old. The Clementine edition was printed in Venice in 1485. Its woodcuts detailing the orbits of the planets, the sun and the stars were hand colored after the page was printed to show broad areas where the celestial orbits might wobble.

It was not until a century later that rubricated lines of type or parts of woodcuts were regularly printed in books. The reason was simple economics. It was an expensive process to pull the black-ink impression of a page, change type, change inks, and then reimprint the same sheet. It took twice the time. And it was hard to make the red inserted material line up exactly where it was supposed to. A splendid example of printed rubrication is Cardinal Aegidio Albornotio's *History of War Administration* (Rome, 1628), which overprints a red, tasseled cardinal's hat, a *galerum*, on the title page and at the beginning of each section of the book.

The Clementine collection also includes a number of books printed in exotic alphabets. The Society for the Propagation of the Faith in the 1620s and 1630s published a series of pamphlets in Irish, Cyrillic, Greek, Armenian, Persian, Arabic, Chaldean, Hebrew and Ethiopic. These are among the earliest examples of such printing. Cutting the matrices and making the

510
IMPRESA XLVI.
EXCVBAT IN CVSTODVS
*Che il Vescouo per ben custodire la sua Chiesa vigilante esser deue, non sonnacchioso.*
DISCORSO QVARANTESIMO SESTO.
SE l'huomo spesse fiate alza il fiato, e la voce contra la Madre vniuersale, perche con partialità singulare habbia fauorito assai più di lui gli animali di ragione priui; in vero che la querimonia non solo non è senza fondamento, sostenere la vita humana; l'arte del magnano non l'insegnò lo struzzo, liquefacendo col calor naturale il ferro? l'arte del chirurgo non l'insegnò il pellicano, qualor col rostro appuntato quasi con piccol gamautto il petto si fuena? l'arte del pollaglione non l'insegnò la colomba, mentre nell' ale, come in bolge rinchiusi più volte si vidde portar frettolosamente importanti dispacci? lo scolpire s'apprese dal picchio, che col rostro pun-

Opening page of a chapter of a "bestiary" containing 100 chapters, this one dwelling on subject of vigilance. Holding rock keeps crane guard awake.

MErcuri⁹ habet orbes qnq; & epicyclū. quoꝝ extremi duo sūt eccētrici ꝑm qd. supficies nāq; cōuexa supremi & cōcaua infimi mūdo cōcentricę sūt. cō/caua aūt supremi & cōuexa infimi eccētricę mūdo sibiipsis tm cōcentrice. & centrū earū tm a centro equantis quantū centrū equantis a centro mundi distat. Et ipsū
THEORICA ORBIVM MERCVRII.

This meticulous page is from a book written in about the year 1220, translated from Arabic, and detailing the Ptolemaic universe. Woodcuts were hand colored.

punches to cast the type for these languages was a tribute to enormous industry and genius—because all of them have more letters and connected letters (ligatures) than Latin. The Ethiopian volume, also called Abyssinian on the title page, prints the Gospel According to John in Latin and Ethiopic, adding a transliteration to show what the strange letters would sound like. "In the beginning was the word" thus became "Baka-da-mi ha-la-ua ka-l" in the mouths of 17th-century missionaries.

Gradually, as you range well into Clement's 17th-century books, the engraving—cut in metal—begins to replace the woodcut. Although it lacks the texture and drama of the woodcut, the engraving does compensate by being able to reproduce many more details. One of the most attractive of the engraved books was a guidebook for bishops that outlined their pastoral duties in 100 chapters, each chapter covering a different characteristic of a good bishop as embodied in a particular animal. The chapter on vigilance shows sleeping cranes protected by their night watch, who must stand on one leg and hold a stone aloft with the other. Should he doze, he would drop the stone. The resulting noise would awaken the other birds.

The *vin ordinaire* of the Clementine bindings is a creamy vellum, still soft and responsive to the hand of the reader as he cradles the book in his lap. Thousands of such covers, made from calfskin, line the shelves, both in their limp form or with several old manuscripts or printed pages pasted together to add stiffening inside the binding. In fact, this practice was so widespread that a major source of manuscripts—or at least fragments of them—is to be found inside the covers of early printed books.

Many books are bound in morocco—goatskin, tanned to a rich red with sumac and then tooled intricately with gold leaf. In this process, heated tools in the shape of flowers (fleurons), arabesques or geometrical forms are pressed into the leather through thin sheets of gold leaf. Other tools were used to scribe lines, repeat figures or stamp larger designs.

Countless books have gilt-edged pages; one rare book, a 1542 commentary on Aristotle's *Ethics*, has alternating groups of pages burnished in silver and gold. Goffering, a technique for indenting or embossing designs in the edges of books, is also frequently seen. The most elaborate goffering occurs on a three-volume set of the works of the historian Flavius Josephus, printed in Lyons in 1555.

As you might expect, the Albani coat-of-arms—the trimount, the rainbow and the star—occurs again and again in the Clementine holdings. As stamped on bindings and printed on title pages, it proclaims the powerful family from Urbino with the mountains (the trimount) at its back, looking toward the Adriatic (the star of the sea) and a rainbow (a symbol of divine intervention). It is interesting to see the progress of that coat-of-arms as it is alternately topped by a coronet, a cardinal's hat, and finally the papal tiara, keys and tassels.

Four musical books of the 1720s, however, crown the Clementine collection. The books are elephant folios, about three-feet wide by four-feet long—big enough for an entire choir to read at once. But the surprise is that these books are actually manuscripts. The copyist, Joannes Dominicus de Biodinis, made his large red and black letter forms in such obvious and loving imitation of the best Roman type faces that it is nearly impossible to uncover the fact that the pages were not printed. The fact is, there were no presses large enough to print such huge pages. Nor could there have been typefounders ready to supply the type: a capital "M" in lead, for example, would have weighed about ten pounds. The telltale is the slight impression line that guided the calligrapher's hand as he paid homage to the printer. And in those morocco elephant folios, the art of the book had come full circle. What began as an imitation of the manuscript ends up as a fit subject for a scribe. But back to the needle in the hymnal. There is another scenario that could explain its presence. Suppose you had a score to settle with the baritone who prates so gloriously right in front of your seat in the choir. Just now, he's at the peak of his solo. So carefully lean forward, and unsheath that needle. . . .

Sister Justina Grothe, a Latinist, works full time on intricate task of cataloguing the library. Book is an elephant folio of hand-lettered vocal music. An entire choir can read the large print and notes.

# IN ASSUMPTIONE B. MARIAE VIRGINIS

## Ad Missam

### Introitus

G
Audea- mus omnes in Do- mi-
no diem festum celebrantes sub hono- re
beatæ Mari- æ Virginis de cujus Assumpti-
one gaudent An- geli & collaudant
Filium Dei.
Exercitui cui nomen verbi hominis dicet
ecce opera mea Do-
mino.

*By Rudolph Chelminski*

# *Honk, tweet, blare: sounds of the fair*

*Automatic music machines, from the fairground, owned by a French collector restorer, can be put into shape to ring in the New Year*

Automatic organ, left, "directed" by a Cossack, enthralled the youthful Fournier. He later bought it.

Massive Gaudin organ, bought by noted chef Paul Bocuse and restored by Fournier, has 103 keys, 20 automatic registers, supposedly reproduces the sounds of a 110-man orchestra.

*Photographs by Pierre Boulat*

*Those mighty fairground organs*

Marc Fournier leans on a hand-cranked Limonaire which he copies from the original and sells.

The earliest known mechanical pipe organ was the hydraulus of Ctesibius of Alexandria, a Greek inventor of the third century B.C. As its name implies, the hydraulus used water pressure acting on an air reserve to provide the steady wind supply that an organ needs. The player picked out a tune by opening or closing contiguous pipes.

The *Hornwerk*, the earliest known large-scale automatic organ, appeared in Salzburg, Austria, in the 1500s. Later, in the 1700s, portable hand-cranked barrel organs were developed; they gained wide popularity around the turn of the 18th century. From these hand-operated devices grew the great fairground organs of the 19th century, huge, imaginative music machines whose din rose above the carnival. It was one of these that first mesmerized 12-year-old Marc Fournier in a dusty farm hamlet in France. And it is one of these that, years later, Fournier restored—the largest automatic organ this expert ever tackled (pp. 78-79).

Marc Fournier's obsession with fairground organs began in the Thirties when he gaped at a baroque, polychrome, hand-cranked, 56-key Limonaire, dating from the turn of the century. As the crashing music washed over him, the brisk rattle of snare drums, the perfectly timed pings of bells working under the precise baton of a scarlet-jacketed Cossack bandmaster, Marc apparently heard the call of destiny.

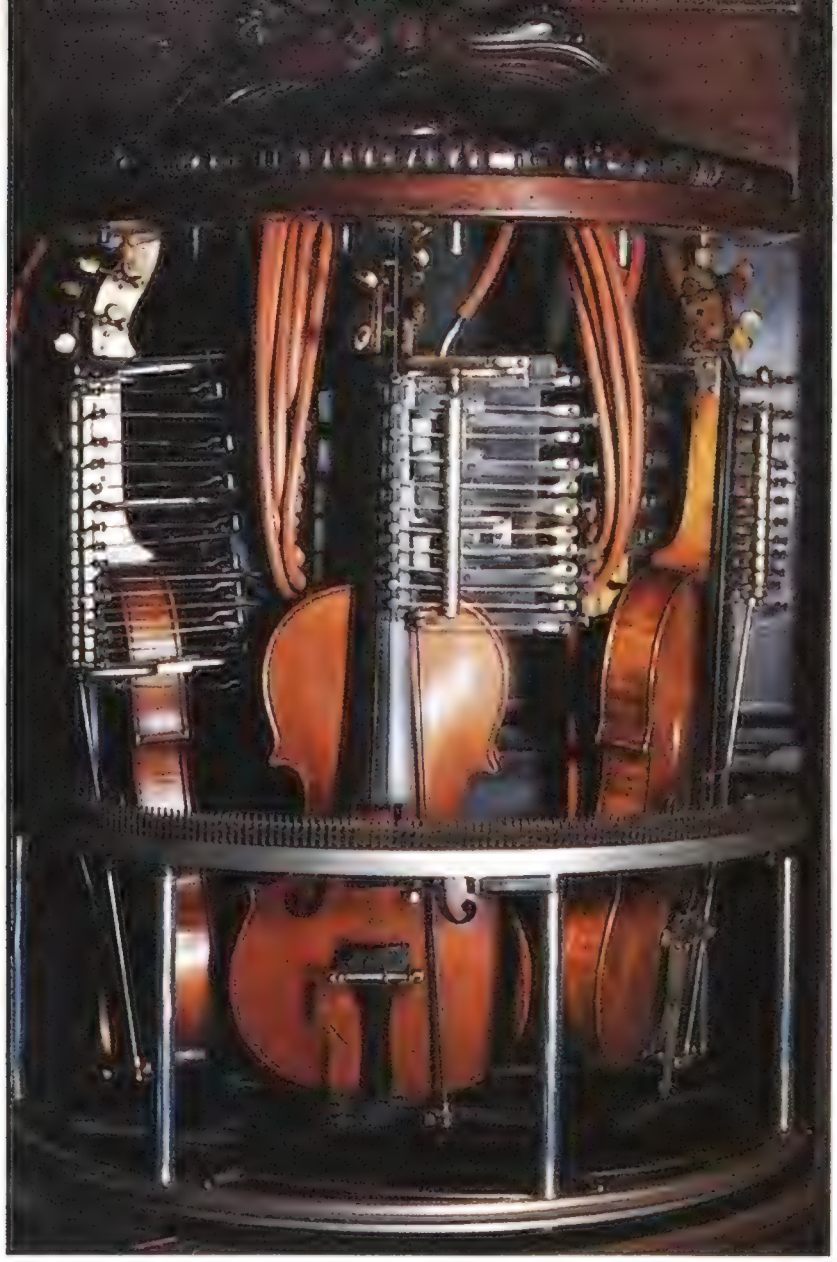
World War II and the tiresome realities of growing to adulthood, and looking for work, intervened. Fournier took a job as a radio repairman, another with a recording studio, and finally bought a distributorship of jukeboxes and pinball machines in the textile town of Vienne, 20 miles south of Lyon. Without realizing it, he was following the pattern of automation and the reproduction of sound. By the middle Fifties, when he was prospering enough to think about a hobby, the old-time music machines were finished. The *forains*, itinerant entertainers who used to drive their caravans of wagons from town to town, had either died, invested in bumper cars or—saddest of all—actually taken up permanent residence and found jobs. Their big organs that had always drawn kids like pied pipers—Gaviolis, Gasparinis, Gaudins and the sweet-sounding Limonaires—were disassembled and parked in barns and back lots.

It was at this moment of ebb that Marc Fournier started looking for fairground organs to buy. Eventually he located a few, then a few more, one contact leading to another. At length he found and bought the very machine which had at first so enchanted him.

Predictably, Fournier was forced to turn over to his two sons the day-to-day affairs of pinballs and jukeboxes and devote himself full time to his musical marvels. The result today is his own private Musée des Limonaires (*limonaire* having become a French generic term for fairground organ) in a tidy hangar-atelier residence next to the railroad tracks at the southern edge of Vienne. In all, he has about 50 machines, of various types and in varying states of repair.

*Rudolph Chelminski, a frequent contributor, wrote the article on "The Rubens Year" in the October issue.*

A larger model stands behind it at right.
The 1902 Gasparini, left, came from a carousel.



Three violins, played one-string-at-a-time
by a circular bow, produce the music of one.

Moreover, after years of bungling experimentation, Fournier has become such a skilled restorer that he can rebuild every part of the organs, from the ground up. He can re-create new-old machines, exact copies of a 1910, 35-key Limonaire—a little hand-cranked model, about the size of a home dishwasher—with an unexpectedly powerful voice. When Fournier feeds in that classic circus march *The Entrance of the Gladiators,* there is enough sound to conjure up instant images of swaying elephants and narcissistic acrobats.

Around 100 years ago, says Fournier, street organs were everywhere. Hand cranked, often by a swarthy Mediterranean with mendicant monkey, they worked by the rotation of a pinned cylinder. Some played a single tune, others may have increased the repertoire to eight or so. On still others, the cylinder could be changed to produce new tunes.

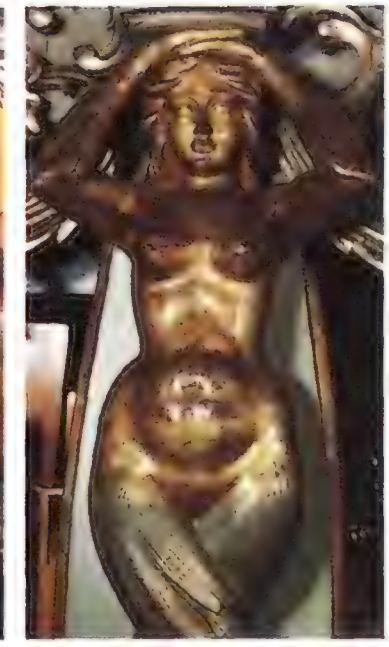
Their popularity grew until they finally became a nuisance to the bourgeois who preferred to count their money in peace. The organs were driven off the streets and manufacturers turned toward large machines.

Fournier has some earlier, barrel-driven models, but the bulk of his collection works on the perforated-cardboard music book system developed in the early 1890s. Punched-cardboard books gave the organs almost infinite capabilities. Fournier's library of perforated booklets comprises everything from the *William Tell* overture to *Rock Around the Clock.*

The music machines, standing shoulder to shoulder on the concrete floor of Fournier's "museum," have baroque decoration, curved and angular wood and gilt plaster, cherubs, sirens, caryatids and languorous, pink-bosomed ladies, beasts, naive landscapes, patriotic slogans, false Corinthian columns. Among his oddities are Antonio, an automatic accordion player (his brilliantined head moves back and forth, his smile is fixed and benevolent, his eyes roll in ecstasy with his complex ruffles and flourishes); an organ and player-piano combination by Imhof-Mukle from a former bordello in Alsace (he swears it still emits a faint aroma of cigar smoke and *filles de joie);* and a 1910 Hupfeld "Phonoliszt Violina," a player piano and violin duo which plays *My Tormented Heart.*

The great fairground organs, 6, 12, even 20 feet wide and nearly as high, sound like John Philip Sousa when he turns them on. Fournier's collection dates mostly from 1870 to World War I. The combination of bad economic times and the rise of the record player diminished the drawing power of the organs, causing a steady decrease in the number of organs

Nymphs and sirens in Gallic dishabille adorn many of Fournier's fairground organs.



His collection consists of about 50 machines, some fully restored, others not.

sold. First Gavioli and Gasparini closed their factories, then Limonaire Frères in the early 1920s and finally Gaudin, too. The organs maintained a precarious career during the Twenties and Thirties, but by then they were reduced to the nickel-dime, hick-town circuit. And by World War II all but one firm was on the verge of closing.

Fournier and his sons take extraordinary pains to restore the organs just as they were built: leather for the bellows, oak for the frame, linden for the statuary, spruce and alder for the wooden pipes and zinc, pewter and brass for the metallic ones. The only concession they have made to modern facility on the big organs is plastic air conduits between the main bellows and the wind chest which powers individual notes. The great organs are belt-driven by electric motors, as most of them were from around 1900 onward, but visiting purists may also crank them by hand.

"Some of the richer *forains* powered them with steam engines in the old days," Fournier explains, "but the hand-cranked ones ran on cheap red wine."

The restored machines are outnumbered by wrecks and pieces of others—Fournier has literally carried some organs back to Vienne in baskets—stored in outbuildings, awaiting the day when he and his sons will have the time to give them their attention. He could accelerate the process by hiring workers, but has not yet found the heart to allow anyone but his own flesh and blood to work on his treasures. His reluctance to sell is notorious and he refuses to even guess at the value of his best pieces. "Inestimable," he says with a shrug, twitching the mutton-chop sideburns which are exact copies of the wooden ones of the Cossack on his 1900, 56-key Limonaire, the very one that called out to him so strongly so many years before. Fournier bought it from the widow of the *forain* who had operated it then. He rebuilt it fully three times before he was satisfied. In his obsessiveness he developed insomnia, often awakening in the middle of the night to stalk out to the atelier and work on it until dawn. His wife Annie grimaces at the memory of 3 A.M. concerts, when Fournier felt the need to test his tinkering.

He has become more relaxed since, but continues to race across France, with occasional forays into Switzerland, Germany and Belgium, any time he hears a rumor about the existence of another old organ. He has little hope of stumbling upon something as fabulous as the monstrous Gaudin any more. Fournier found that rain had leaked on it, the metal was rusted, much of the leather and wood were rotten. Famed restaurateur Paul Bocuse bought the ruin for 12,000 francs (approximately $2,400) and Fournier and his sons spent almost a year putting it back into shape.

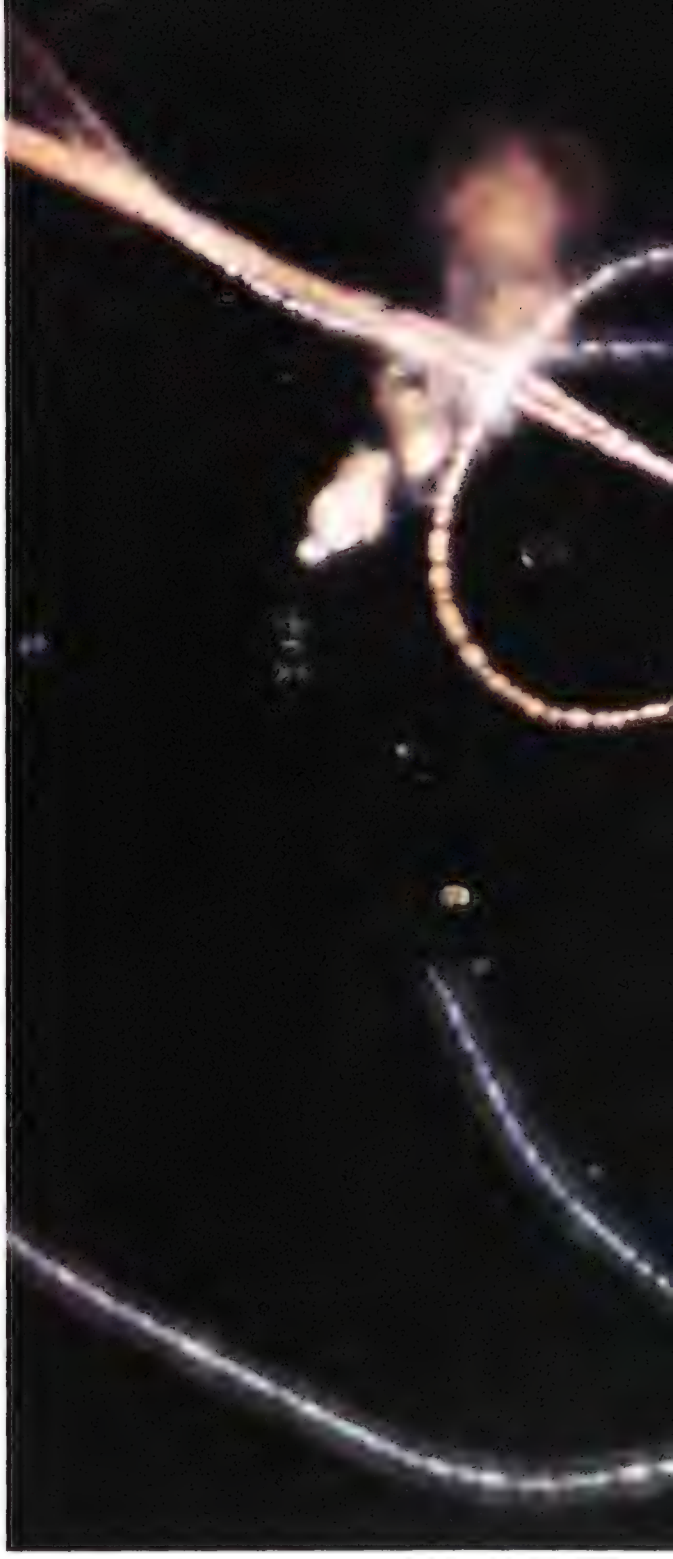
Curiously enough—or fittingly enough—the most immediate and striking effect of the great Gaudin is on children and old people. They seem invariably to gawk in astonished joy at the magic machine, experiencing the same emotion that young Fournier did.

Fournier's search for more machines seems certain to lead him across an ocean: he wants a calliope—a purely American steam organ, never manufactured in Europe. "The quality of their music was frightful," he says, "and you sat in a rainstorm when you played them because of the condensing steam—*mais quelle belle machine!*"

Three statuettes on the 1902 Gasparini are animated, moving in time with the music.

GASPARIN

This freshwater pond appears serene, but under its surface are the spectacular animals shown in following micrographs.



Algae, like the filamentous inhabitant at right, are among the primary pond producers, analogous to grass on prairies.

*By C. W. Hart jr.*

# Familiar ponds harbor mysteries, exotic animals

*They hold the components of ecosystems, and after years of study we still do not know life cycles of many of their inhabitants*

When people think about a pond and the organisms in it, the thoughts usually turn upon fish—as immediate prospects, as the potential victims of pollution or, in many cases, as nostalgic evocations of long childhood summer days spent fishing for bluegills with doughballs or earthworms impaled on tiny hooks. Pond thoughts can conjure up long-forgotten explorations of cattail jungles and water-lily tangles at the water's edge, of encounters with dark and mysterious mussels and magically protean leeches in the cool slippery bottom ooze.

But whatever the thoughts, most often they relate only to one or two relatively obvious facets of that complex web of interrelationships that makes a pond. Seldom are we carried beyond the obvious into the secret workings of that ubiquitous and largely self-contained ecosystem that touches so many of our lives at one time or another. Seldom do we catch more than a glimmer of the pieces of that marvelous mechanism

that is the pond as a whole, interacting within itself and with the sunlight, and repeating, year after year, the subtle patterns of life and death and survival imprinted upon it by time.

I say "largely self-contained" because, except for nutrients entering from the surrounding countryside, the all-important energy input of the sun, evaporation and runoff of excess water, and a relatively few other phenomena, a pond *is* self-contained. Undisturbed by too many nutrients, toxic substances, drought or other perturbations, the pond exists—balancing gas exchange against vapor pressure, light against darkness, equilibrium against turnover and life against death.

But what is an ecosystem? Despite the almost ritualistic everyday use of the word in the media, it remains to many people a somewhat nebulous concept, thrown about along with "ecology," "endangered species," "pollution" and other emotion-laden and ill-defined catchwords. Suffice it to say here that all organisms—be they large or small, plant or animal, aquatic or terrestrial—are inextricably interrelated with one another and with their physical environments, and that they form natural, more or less self-sufficient groupings that we call "ecosystems." For convenience, a typical ecosystem can be thought of as being divided into four components: the *nonliving substances,* the *producers,* the *consumers* and the *decomposers.* (Although some of these may be absent in specialized circumstances, the four are usually present.)

The nonliving (abiotic) components of the pond ecosystem comprise not only the familiar bottom ooze, which is largely the product of the decay of living things, but also the gases, minerals and nutrients that are dissolved in the water and upon which most of the

*An invertebrate zoologist, the author combines research with administrative duties at the Smithsonian's National Museum of Natural History.*

*Photographs by John Walsh*

Eggs are visible in the brood chamber on the back of this water flea; animal is about a millimeter long.

Here, in a close-up, young water fleas escape from brood chamber into the

organisms that live in it depend. Despite the common belief that a clean environment calls for "pure" water, the achievement of such a goal would spell sure disaster for many aquatic organisms, because most organisms depend for their survival upon the gases, the nutrients and the minerals dissolved in the water. Waters devoid of such dissolved substances (oligotrophic waters) are often largely devoid of life. There is simply little to sustain it.

Conversely, too great an amount of these things also spells disaster. An overabundance of nutrients, nitrates and phosphates, for instance, can cause "blooms" of microscopic plankton organisms which, in turn, consume too much of the dissolved oxygen and thereby bring about the obvious fish kills. All too often the first overt sign of a polluted condition is when the fish begin to die, but at that stage the trouble is most likely deep-rooted, having previously manifested itself only in subtle, almost imperceptible, ways. It is like the patient who suffers a heart attack, only to find that the condition had begun to develop years before.

In an ecosystem, the producers comprise that group of organisms that combine the energy of sunlight with simple inorganic and organic compounds to synthesize new living material, to "fix" the sun's energy. These are usually the photosynthetic plants, and in a pond situation they range from the obvious rooted aquatics, such as water lilies and bulrushes, to the microscopic algae, often dominated by the jewellike diatoms and delicate desmids.

Some of the microscopic algae live attached to substrates, including other plants, and are called, as a group, by the German name *Aufwuchs*; others float free in the water, and are known as phytoplankton. The producers are the living basis of the ecosystem, the continually renewable foundation upon which the other organisms depend. In a forest, the trees are the important producers; on a prairie, the grasses carry out that function; and in the pond, as well as in larger bodies of water, floating algae in open water and rooted plants in the shallow water do the job.

Algae (Cyanophyta) have been shown to "fix" nitrogen in ponds (p. 85), as members of the pea family "fix" nitrogen in soils. Moreover, the blue-green algae, when present in sufficient numbers and in certain species compositions, are also known to be "indicative" of the presence of organic pollution. It should not be thought, however, that because one finds one or more so-called "indicator" organisms in a body of water that the water is necessarily polluted. Representatives of the most pollution-tolerant of organisms may be found in any waters; it is only when their relative numbers are out of balance, or other conditions prevail, that they may be said to indicate pollution. The "pulse" of a body of water is not an easy one to find.

Farther up the scale are the consumers, which generally fall into groups—the primary consumers and the secondary (and even tertiary) consumers. These are the organisms—chiefly animals—that ingest other organisms. In any particular ecosystem the primary consumers are herbivores, which feed on the producers and consequently make use of the sun's energy previously fixed by them. Some primary consumers (certain protozoans, crustaceans, mollusks and worms, for example) are bottom-dwelling herbivores—spending most of their lives on and among the bottom mud and litter and consuming the plant material growing there or falling to the bottom. Other primary consum-

waters of the pond. From now on, they will be prey and predator.

Young swim near female shortly after release. Water fleas produce up to 20 offspring at a time.

ers are the herbivorous zooplankton (largely microscopic crustaceans) that live in the open water and consume the phytoplankton there.

*Stylaria* is an example of the tremendously important and cosmopolitan group known as annelid (segmented) worms (p. 88). Most of the annelid worms, relatives of the common earthworms, occupy sandy to muddy bottoms of streams, rivers, ponds and lakes. They are generally, but not always, adapted to a burrowing existence, where they continuously take in large volumes of sediment and extract from it the small portion of nutrient material contained in it.

As with the blue-green algae, certain of the annelid worms (sludge worms, for instance) have become so associated in people's minds with gross organic pollution that undue alarm is felt when any are found in a supposedly "clean" environment. Such alarm should be tempered with caution until more detailed analyses of numbers and kinds of species are made.

The omnipresent rotifers comprise one diverse and abundant group of animals acting chiefly as primary consumers, although some are certainly secondary consumers as well. First studied by Leeuwenhoek in 1703, these microscopic creatures are called rotifers because, in some species, the anterior end (corona) is equipped with disclike ciliated organs whose synchronous beating causes them to resemble counterrevolving wheels which sweep food into the mouth. More than 1,700 species of rotifers have been described.

The protozoans *Vorticella* and *Paramecium* (pp. 88 and 90), as well as the crustacean water fleas (above), also function chiefly as primary consumers.

The secondary consumers—those that feed chiefly on the primary consumers—are called primary carnivores because they are the first line of animals that consume *other* animals. These are usually the smaller fish, crustaceans and certain of the larger insects.

Crawdaddy, crawfish, crayfish or mudbug—call it what you will, but few will deny that aside from fish and frogs it is the best known and, in a perverse sort of way, best loved inhabitant of our ponds and streams. Underprivileged is the child who has not at some time groped blindly under root-ridden banks or beneath rocks in stream riffles to capture these backward swimming and benignly fierce creatures replete with snapping claws and aggressive indignation. Omnivorous, almost ratlike in their dietary habits, the crawfishes feed on succulent vegetation (primary consumerism) and other animals (secondary consumerism). When maintained in the laboratory, many species thrive on commercially prepared cat food. In some places crawfishes themselves are prized as human food, and crawfish farming is a thriving industry in the United States and in other countries.

And then the tertiary consumers (secondary carnivores) feed on the primary carnivores, becoming the most obvious participants in the food chain of the pond ecosystem. The tertiary consumers are usually the larger fish, those that one instinctively thinks about when pond thoughts intrude. They are the highest level of that complex pyramid of pond life, but depend ultimately for their survival upon the sun's energy, fixed by the primary producers and passed on to them through the several organismic levels comprising the ecosystem.

But, as all organisms ultimately die, a fate common to producers and consumers alike is the natural recycling of their bodies by the decomposers. Decom-

posers in an ecosystem are the fungi and the bacteria (p. 91), whose chief function is to break down the dead material into relatively simple organic compounds and molecules that can, in turn, be used and reused by succeeding generations of both producers and consumers. The fungi are often visible to the naked eye; the bacteria, unless present in vast numbers, are too small for that.

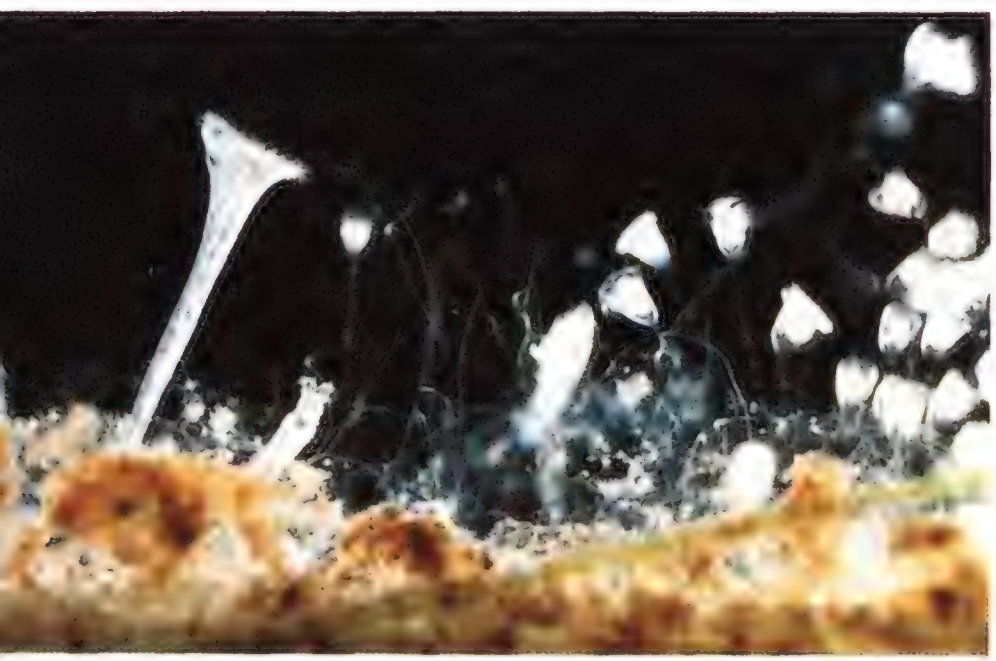
In typical pond situations the bacteria are always active and appear to respond to the pond's needs in seasonal cycles related to algal production and detritus inputs. Curiously, little research has been done on the rates at which organic material is transformed by the bacteria, but it has been shown that bacterial activity is far greater in polluted systems than in those systems containing few nutrients.

(I find it interesting, even if inconclusive, to speculate on the parallel between the comparatively recently recognized producers, consumers and decomposers of the ecosystem and the ancient Hindu triad of Brahma, Vishnu and Siva—the creator, the preserver and the destroyer. It is as if, at a very early time, certain ecological principles had been recognized to be so basic as to be guiding principles of a religion.)

It should not be thought, however, that each of the ecosystem levels is entirely discrete. For whereas a primary consumer might feed mainly on plant material, as with the rotifers, it might also ingest small animals as well; a secondary consumer, feeding mainly on animals, will usually ingest plant material too.

In natural ponds the populations of various plant and animal species are large enough to compensate for environmental variations and predator pressures and to ensure the reproduction of the species. A large population of any one species is rarely found in natural conditions, and should one occur, as in the algal blooms, it is quickly reduced by predator pressure. Only in polluted conditions, where predators have been removed, will one find the same species in great abundance for a long period of time.

Our wishes and needs notwithstanding, there is no one index or model that can be depended upon to describe an ecosystem completely, even a simple self-contained one. Rather, a balance of many techniques—including studies of species compositions, population sizes and the physical-chemical environments to which they are exposed—must be employed. The task is not easy, and it is further complicated by the fact that even today literally thousands of organisms that inhabit our waters remain undescribed. And unless an animal has



Disintegrating leaf (along bottom) becomes home for protozoans, *Stentor* at left and *Vorticella* at right.

This annelid worm, of a group found in ponds all over the world, is related to the common earthworm.

# Pella wood windows offer more insulation for less money

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Paramecia such as these (the one at left is dividing into two) are among simplest animals but play an important role in the pond ecosystem. They help start decaying matter back up the food chain.

been properly described, unless something is known of that particular species' habits and tolerances, its use in ecosystem studies is of limited value.

In studying aquatic life one finds that the lack of data on just the "normal" ecology of most organisms—let alone the extent to which individuals or communities indicate degrees of pollution—is disheartening. Considerable work has been done, but concern has been with relatively few organisms.

Arthur Upfield, an Australian, wrote a haunting murder mystery called *Death of a Lake*. The lake in Upfield's novel did not die in the sense that some still think Lake Erie is dying from intolerable pollution input; it simply dried up as it had been doing periodically for centuries because of the caprices of the Australian climate. Lakes and ponds may die, temporarily perhaps in the larger scheme of things, from excessive pollution. And ephemeral ponds, depending upon local rainfall to last throughout a summer, are common—often inhabited by the strange semitransparent fairy shrimps, swimming aimlessly on their backs as if looking to the sky and hoping vainly for the reprieve afforded by yet another rainstorm.

But it is often overlooked that virtually all lakes and ponds themselves have a birth, a middle life and a death which may be, for the most part, independent of Man or climate. Skipping the forces that originally form the lake or pond basin, a "young" lake in the temperate zone is typically oligotrophic, possessing scant organic nutrient material and generally having a poorly developed littoral (shore) zone. In time, nutrients build up in the water from erosion and from the inflow of water containing decomposition products. The bottom becomes heavy with rotting debris as higher plants emerge in the littoral zone and the biotic variety in the water increases. Sediments and organic material accumulate, resulting in a decreasing of the pond's circumference and in a gradual filling of the deeper zones. Imperceptibly, over many years, the shallowing waters permit plants which formerly grew only at the water's edge to extend farther into the pond until, at last, they meet in the center. The zone that was once littoral is now a marsh; the center only a vestige of the earlier pond or lake. The death of a pond comes about naturally and inexorably.

Looking like galaxies in a science-fiction movie, these microscopic decomposers recycle organic matter.

*Hail to 14 forgotten Chiefs!*

*By Richard B. Morris*

# Meet the men who were Presidents before Washington

*They were the leaders of Congress who accepted the role of Chief Executive before the Constitution defined it*

On January 20, 1977, Jimmy Carter took the oath of office as the 39th President. By another calculation, he is actually the 54th. It depends on whether you count from the first election of a President under the Constitution, from the first President under the Articles of Confederation, or from the start of the United States as an independent nation.

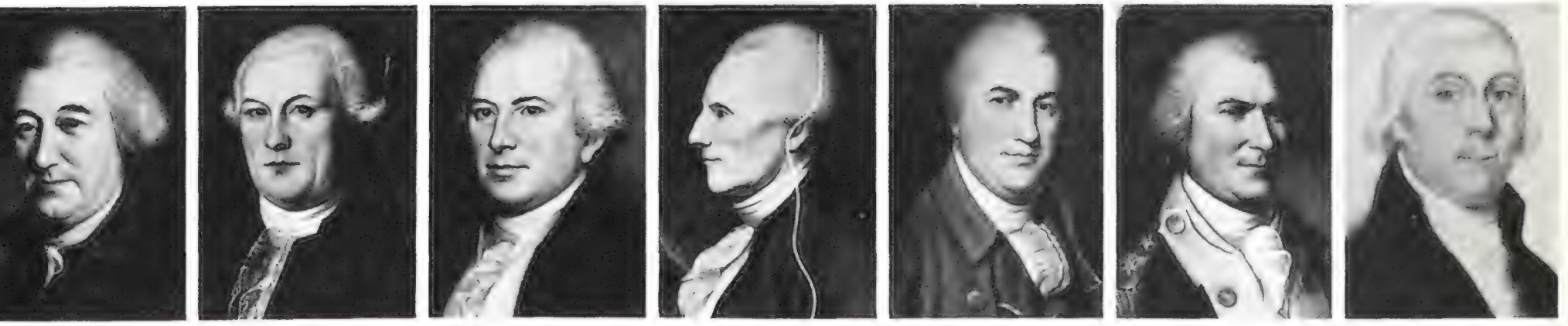
From its inception, our country has had three different names. Until the ratification of the Articles of Confederation in 1781, it was known as "The Congress"; under the Articles of Confederation it was called "The United States in Congress Assembled"; under our present Constitution it is "The United States of America." No matter what we call it, the United States has always had a "President." From the First Continental Congress (1774), to the last session of the original Congress (1789), 14 different Presidents were elected, serving an average of a year apiece. One, John Hancock, held two widely spaced terms but never appeared in Congress during the later one.

Since these Presidents exercised the first glimmerings of executive power under the central government, and since six of them preceded the formation of the Executive Departments, their role foreshadowed the Presidency as we now know it. Their authority developed from necessity. What they did and how they did it depended in no small measure on their personalities and the political situations which confronted them.

From the start, Congress assumed executive power. Soon that power was shared with the Commander-in-Chief, and then portions of it were parceled out to ad hoc committees. However, a degree of executive authority had always been exercised by the President of the Congress from that very first session in September 1774, when Peyton Randolph, the Virginia aristocrat, was unanimously elected to that post.

As a delegate, the President had the power to vote and to serve on committees like every other delegate. He received and answered letters addressed to the Congress, and carried on correspondence with state governors, military commanders and diplomats abroad. He was occasionally authorized to draft resolutions or addresses on behalf of Congress; even where they were drafted by others, they were invariably issued under his signature. He was in effect the administrative head of state, although no executive powers were ever formally conferred upon him.

As Congress' social functionary, the President was its undisputed first member. Protocol demanded that the dais on which he was seated be elevated above all others. He was expected to receive official guests and give dinners, levees and balls, foreshadowing the high

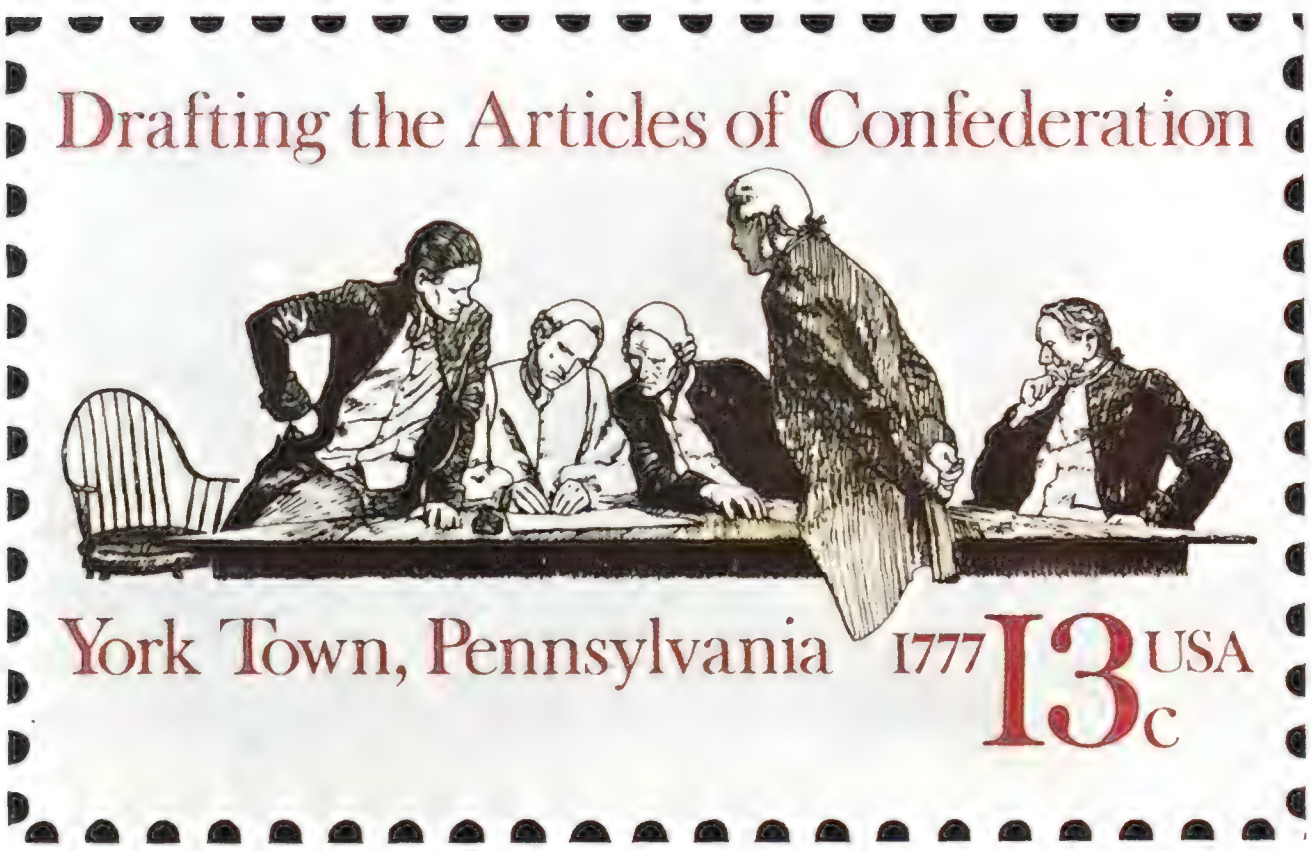


tone set later by President Washington in New York.

Buried in Article IX of the Articles of Confederation is the provision that "no person be allowed to serve in the office of president more than one year in any term of three years." However, even before the Articles of Confederation went into effect, the average length of Presidential tenure was under a year. Henry Middleton served for a mere five days, and John Hancock, the most durable incumbent, presided for two years and five months. This rapid rotation made it possible to have most of the states represented in the Presidency. Only New Hampshire, North Carolina, Rhode Island and Georgia failed to fill that office with one of their own delegates.

Lacking clear guidelines, the Presidents of Congress could, with some discretion, influence events, formulate the agenda of Congress and prod it to move in directions they considered proper. All were sturdy individualists, with strikingly diverse traits; some held strong convictions about the need to enhance executive power. Yet they do lend themselves to a composite portrait: except for General Arthur St. Clair, a Scot, and Henry Middleton, born in London, all the Presidents were native-born Americans. All were mature, experienced politicians who had been actively involved in the drive to independence. Their average age at time of election was 47. John Jay, the youngest (and also one of the more conservative), entered upon his duties at 34; the earliest born, Henry Middleton, served briefly at 57. Maryland's John Hanson was, at 60, the oldest in office. Five were in their fifties.

Most were well-educated by the standards of the




Commemorative stamp recalls dark days of the Revolution when Congress, led by John Hancock, fled to York, Pennsylvania, and drafted this document. It lacked teeth enough to hold the states together. Since no credible engraving of the scene existed, designer had to create this imaginary scene.

Independence National Historical Park

Peyton Randolph of Virginia presided over both First and Second Continental Congresses in 1774 and 1775. He studied law at London's famed Inns of Court.

time. Peyton Randolph, the first President, and Cyrus Griffin, the last, were Middle Templars, whose attendance at the Inns of Court in London had given them basic legal training. Griffin and St. Clair had attended the University of Edinburgh. Of the remainder, most had the benefit of private tutors or had studied at newly emerging academies. Least exposed to any formal education appears to have been Nathaniel Gorham of Massachusetts, who early in life was apprenticed to a merchant. John Hancock was a Harvard man, John Jay graduated from King's College (now Columbia) and Thomas Mifflin attended the College of Philadelphia (later the University of Pennsylvania).

Perhaps the wealthiest among them were Henry Middleton, the great plantation owner of South Carolina; his fellow Carolinian, Henry Laurens; and Boston's leading merchant shipper, John Hancock. Nearest to being a self-made man was Samuel Huntington of Connecticut, who found the expenses involved in maintaining his social position as President especially burdensome.

Prior to the adoption of the Articles of Confederation, three Presidents decisively shaped events. The first was John Hancock. Although the initiatives in the moves toward independence were taken by Richard Henry Lee, author of the original resolution for independence, it was Hancock as President of Congress who alone affixed his bold signature to the eventual Declaration of Independence upon its adoption on July 4, 1776, to which Charles Thomson, Congress' permanent nondelegate secretary, attested. Others of the delegates to Congress were either too timid or too involved to sign for another month, and in some cases for a good many months more (SMITHSONIAN, July 1975).

That document was a renunciation of allegiance to the King of Great Britain, an affirmation of the right of revolution and a declaration of war. Since it sought to place the stamp of legality upon an act of secession from the empire, it had to carry a signature. It was Hancock's that provided it with the necessary authentication, thereby singling out the President of Congress for the special animus of King and Parliament.

Although the Declaration was Hancock's climactic achievement, it also must be recognized that under his Presidency Congress had commissioned General Washington, set up a military establishment, emitted bills of credit, established a secret committee to secure aid abroad and issued a call for the Colonies to organize state governments. Granted that Hancock was not the initiator of any of these actions, and that he would have much preferred the role of commanding general to that of President, yet they were all taken in his name, and his Presidency marked perhaps the most creative span of Congressional initiatives.

Hancock was the first American President to issue a farewell address. Although that practice was hardly institutionalized that early, the circumstances surrounding it shed light on the incumbent's conception of his office. He had been dwelling in Philadelphia in a state of considerable

*In our July 1975 issue, Richard Morris discussed the impact of Independence. He is now editing the John Jay papers; Volume I was published recently.*

Middleton Plantation

Henry Middleton of South Carolina served only five days in 1774. He was probably richest of the 14, reputedly owning some 800 slaves.

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**The following is reprinted from APIDEA, the Associated Photographers International Publication, November 1977**

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*Hail to 14 forgotten Chiefs*

opulence but, when the British occupied the capital, he took his lovely young bride, Dorothy Quincy, to a variety of makeshift homes where Congress was forced to sit—Baltimore, back to Philadelphia, thence to Lancaster and York. In October 1777, Hancock declared that his impaired health mandated a leave of several months. Congress jumped at the chance to replace him. A vote of thanks for his services was grudgingly accorded him, and three days later he was replaced by the merchant prince from South Carolina, Henry Laurens.

The first activist President of Congress, Laurens was also the first to form a firm opinion of the need for strengthening executive power in the central government. Vain, combative and indiscreet, he presided with little pretense of impartiality. At times his temper outran his prudence. He almost came to blows with the fiery secretary, Charles Thomson, who made no secret of his disapproval of the President's behavior. Laurens found his fellow delegates ruled by "venality, peculation and fraud." He was shocked at evidence of graft in the administration of the war. He even compiled a dossier on graft and grafters, but kept it to himself, and it remains in his unpublished diaries.

Laurens participated in debate more

Museum of Fine Arts, Boston

Wealthy John Hancock of Boston was twice elected but did not serve a day of his second term. His first term saw the Declaration of Independence.

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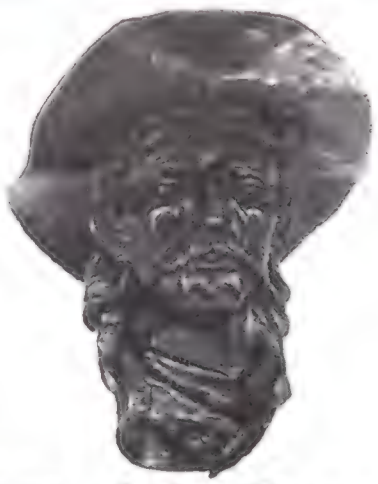

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actively than had any previous President, exercising his prerogatives as a delegate. As President, joining forces with Samuel Adams of Massachusetts and Richard Henry Lee of Virginia, he became a leader of the faction in Congress that was critical of the French alliance and, more particularly, highly suspect of the integrity of Silas Deane, one of the three commissioners to France, whose long-smoldering feud with Arthur Lee, a fellow commissioner, split Congress virtually down the middle.

Henry Laurens, fiery South Carolinian, tried to beef up executive power,

Shocked by the generous terms that General Horatio Gates had granted British General "Gentleman Johnny" Burgoyne on the latter's surrender at Saratoga in October 1777, Laurens was determined to block the implementation of the so-called Saratoga Convention, the surrender agreement. Although bedridden with gout, Laurens was carried into the House

to participate in the debate on this issue and played a major role in having the Convention abrogated. As a result, Burgoyne's captured army was not permitted to sail for England, but was kept in captivity in America until war's end.

When Congress recalled Deane from France, Laurens treated him as though his guilt had been incontrovertibly established. Deane took his case to the public through the press. Thereupon, Laurens

National Portrait Gallery

resigned in a huff in 1778, later served as Peace Commissioner at war's end.

moved to suspend hearings of the accused commissioner pending a committee investigation. When his motion failed of passage, he regarded it as a vote of no confidence and tendered his resignation in a dramatic and prolix farewell address. If Laurens had hoped for vindication, he was quickly disabused. Congress accepted his resignation and at once chose in his place a stalwart supporter of Silas Deane. This was the youthful and eloquent law-

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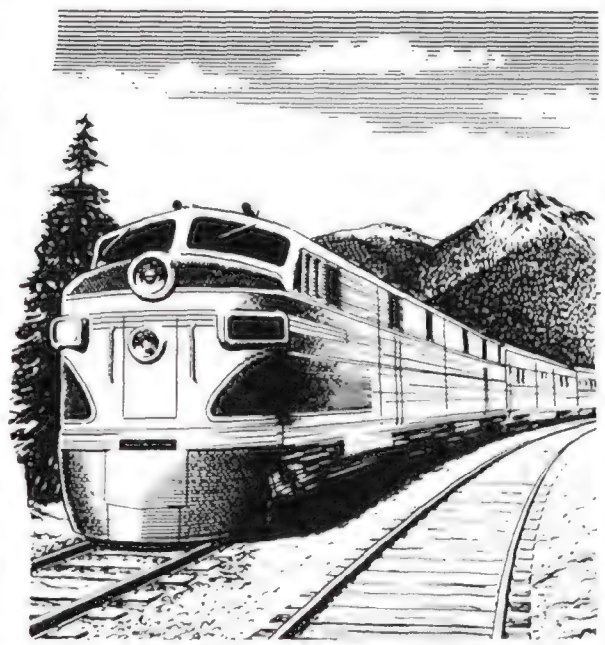

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*Hail to 14 forgotten Chiefs*

Independence National Historical Park

Samuel Huntington took office in 1779 and served until 1781, the year the Articles of Confederation were ratified. He later became governor of Connecticut.

yer from New York, 34-year-old John Jay.

Jay entered office when the dispute over the conduct of Silas Deane in Paris was seething. Matters came to a boil when Thomas Paine, then serving as Secretary to the Committee for Foreign Affairs, committed a gross indiscretion. In an effort to bring down Deane, Paine publicly disclosed secret information about French aid to the United States prior to the formal alliance of 1778. Even though France had been at war for almost a year, Paine's revelation was considered an embarrassment to France and a reflection on the French King's honor. The French minister insisted that Paine be disciplined and Congress repudiate his statement.

The result was a hearing in Congress

National Portrait Gallery

John Jay, at 34 the youngest of the 14, served in 1778-79, seeking sovereignty of Congress over states. He chastised Tom Paine for "leaking" news of French aid.

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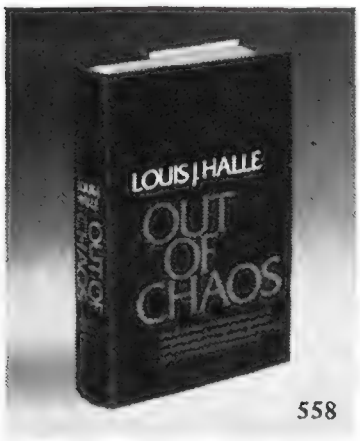


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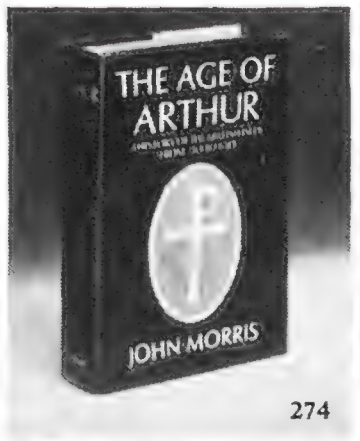


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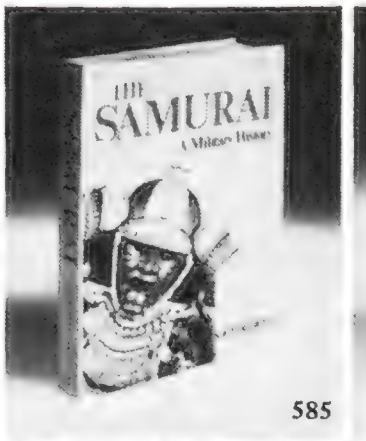


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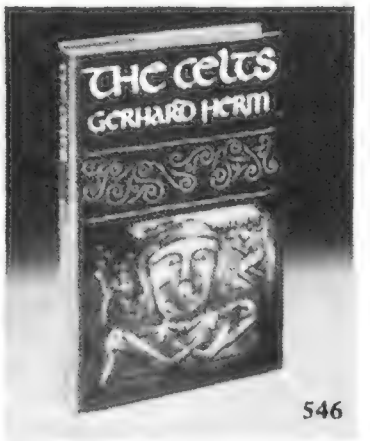


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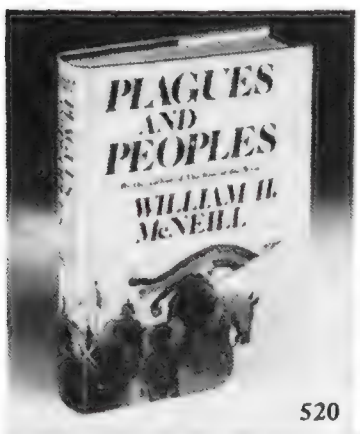


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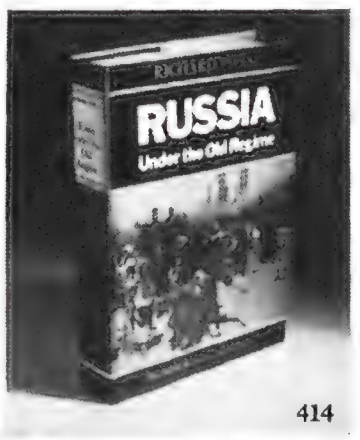


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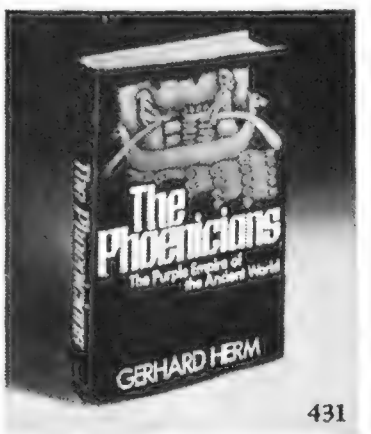


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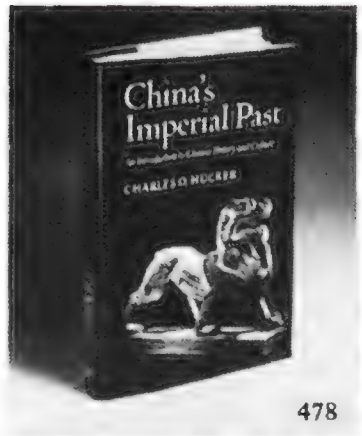


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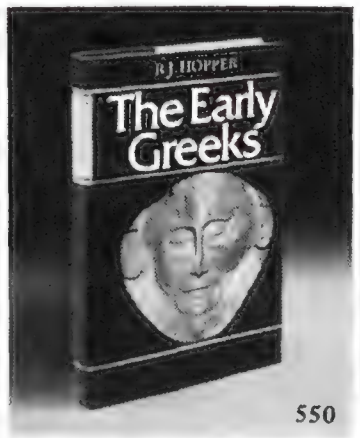


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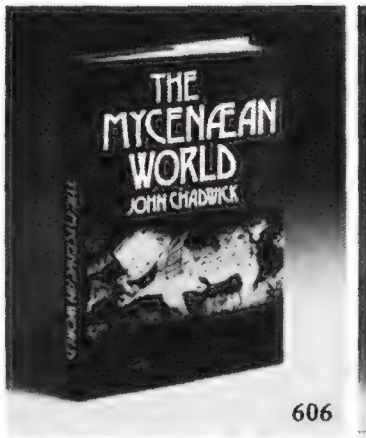


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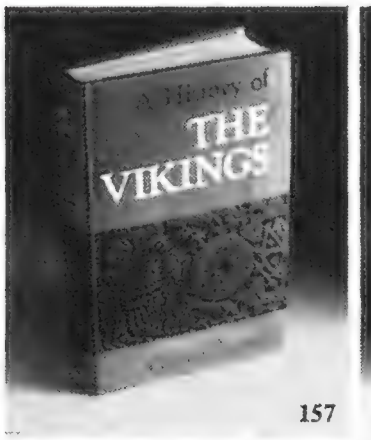


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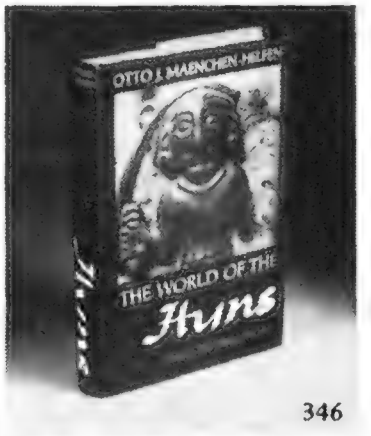


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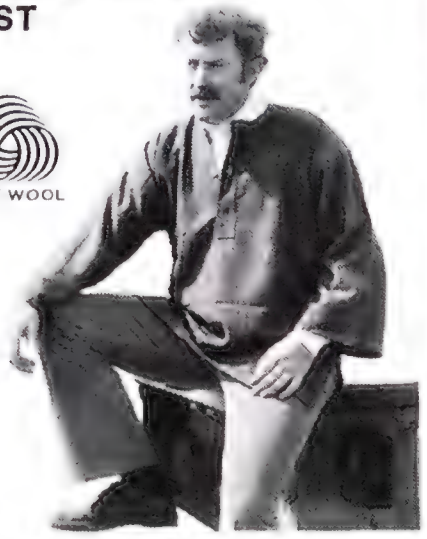

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Thomas McKean served four months in 1781. A Delaware lawyer, he kept a political thumb in Pennsylvania and eventually became its governor.

over which John Jay presided. Paine was called to the bar of the House, sharply questioned by President Jay and was dismissed from office by Congress (in anticipation he had already resigned). Congress disavowed Paine's published disclosures and formally denied that prior to the alliance France had given America any supplies whatsoever. This, of course, is what we know as a "cover story." Jay was later to pass it on to the minister with seeming relish.

More than once, Jay as President asserted fundamental tenets of national sovereignty. When Pennsylvania refused to accept Congress' jurisdiction over cases in Admiralty, it was Jay who asserted that "Congress is by these United States invested with the supreme sovereign power of war and peace."

Throughout Jay's Presidency currency deterioration and price inflation proved major concerns. In January 1779, he issued an "Address to the People on the Currency" in which the issuance of bills of credit was vigorously defended and blame for depreciation attributed to the enemy for widespread counterfeiting. As resentment against speculation reached a fever pitch, Congress placed a ceiling of $200 million on the emission of bills of credit and instructed President Jay to send out his "Circular Letter from Congress to their Constituents." In that impressive state paper, the President called on the states to pay their taxes and advocated reducing the amount of money in circulation, relying henceforth on loans and taxes. Reminding his readers that the credit of the United States rested on the success of the war, Jay reassured them that "the independence of America is now fixed as fate, and the petulant efforts of Britain to break it down are as vain and fruitless as the raging of the waves which beat against her cliffs."

Finally, much of Jay's Presidency was taken up with debates over peace objectives. His experiences presiding over these arguments prompted him to observe

Independence National Historical Park

John Hanson was the oldest (60) of the 14 and first to start his term under the Articles. A Marylander of Swedish stock, he died in 1783, a year after leaving office.

to George Washington that "there is as much intrigue in this State House as in the Vatican, but as little secrecy as in a boarding school."

After Jay's Presidency Congress was concerned with thorny issues, but its President did not play a decisive role. More and more executive and administrative duties were being assumed by new department heads or secretaries. Since the Articles of Confederation made no change either in the powers of Congress or in the character of the Presidency, the Presidency was if anything diminished in effectiveness after the Articles went into operation. An exception, perhaps, was the tenure of Elias Boudinot of New Jersey, who for a time doubled as President and ad interim Secretary for Foreign

The Art Museum, Princeton University

Elias Boudinot, called "elegant, eloquent and emotional," served in 1782-83, and signed peace treaty with Britain. This rich New Jerseyan was Washington's friend.

Affairs, the Confederation's version of what later became Secretary of State.

Richard Henry Lee of Virginia, renowned libertarian and jealous advocate of states' rights, was the most distinguished incumbent of the Congressional Presidency during the years of the Confederation. But the prestige of the office had declined along with that of the Congress itself. John Hancock, although elected again to the Presidency in 1785, never came to New York to perform his duties. His pretext was ill health, but, as a fellow delegate remarked, "the President's chair" was "the Easiest in the Union for an invalid."

Independence National Historical Park

Pennsylvania's Thomas Mifflin, who served 1783-84, had been ousted by Quakers for war service. He failed as Quartermaster (note Valley Forge).

On receipt of Hancock's letter of resignation, Congress chose Nathaniel Gorham to fill out the remainder of Hancock's term. Gorham, a prosperous Boston businessman and advocate of a strong cen-

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Richard Henry Lee of Virginia was President 1784-85, when the office, under Articles of Confederation, lacked clout. He had actively urged independence.


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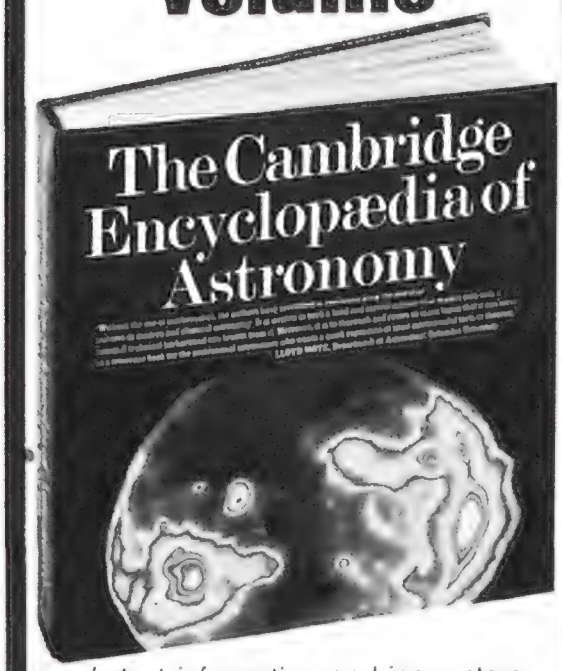


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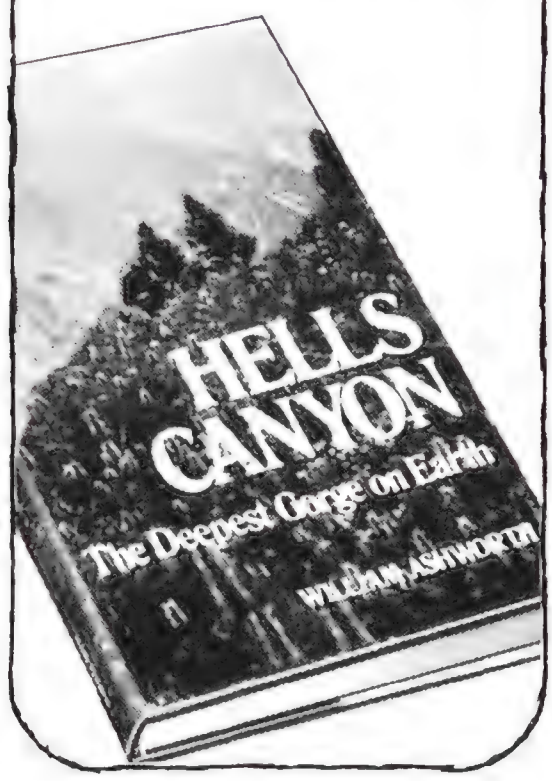


*Hail to 14 forgotten Chiefs*

Independence National Historical Park

Scottish-born Arthur St. Clair saw action in the Revolution as a general. He presided over Congress in 1787, then governed the Northwest Territory.

tral government, did something quite startling for a President. If we are to believe the later charges of James Monroe, he sent an invitation to Prince Henry, brother of Frederick II of Prussia, to become King of the United States, provided that the kind of constitutional change then being considered should be along British lines. Gorham appears to have acted entirely on his own, without authorization of Congress or any committee thereof, nor did he ever take Congress into his confidence.

While the Constitutional Convention was drafting the great charter of our federal government, Congress adopted the Northwest Ordinance, in July of 1787, organizing the Northwest Territory—between the Ohio and Mississippi Rivers and the Great Lakes. It so happened that the Ordinance was passed during a fortnight's absence of the President, General Arthur St. Clair. Since St. Clair himself was named governor of the new territory in October of 1787, there is still a cloud of speculation about conflict of interest. Was he instrumental, first, in seeing that a tutelary system rather than self-government would be an initial stage of territorial government, thereby enhancing the powers of the governor? Was his appointment a quid pro quo for his support? The issue was never settled.

There has been a good deal of brouhaha about who was the *first* President. Most vocal have been the supporters of the claim of John Hanson, of Mulberry Grove, Maryland, who held tenure during the year beginning in November 1781. Hanson was of Swedish origin, so he stood out from most of the other incumbents.

Except for John Jay, who boasted that he did not have a drop of English blood in his veins, the remaining 12 were of British origin. But ethnicity, with due obeisance to the enthusiasm of Scandinavian-Americans, had little pertinence to the issue.

Museum of Fine Arts, Boston

Nathaniel Gorham's term was in 1786. He had little formal education, having risen through the commercial ranks in Massachusetts from a mere apprentice.

The claim that Hanson was the first President of the United States in Congress Assembled is tenuous. Hanson was the first of the Presidents of Congress to *begin* his term at the start of the federal year provided by the Articles of Confederation, but both Samuel Huntington of Connecticut and Thomas McKean of Delaware preceded him as Presidents under the new government. A strong case could be made out for Huntington, but stronger cases for Peyton Randolph, first President of both the First and Second Continental Congresses or John Hancock, President of Congress when that body declared its independence.

Considering the character of the office, and its limitations, it is clear that one is describing an incumbent who was but first among equals in the Congress—a far different position from the chief executive whose powers were enumerated by the framers of the federal Constitution. If you ask any schoolboy who was the first President he will answer, one hopes, "George Washington." And he would be substantially correct.

Cyrus Griffin of Virginia, last President before Washington, had headed the Congressional Court of Appeals, the forerunner of the Supreme Court.

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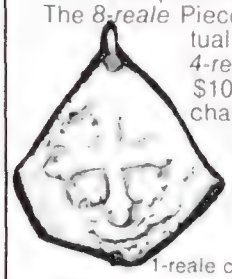

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# *Book reviews*

*A Pattern Language*
Christopher Alexander, Sara Ishikawa, Murray Silverstein with Max Jacobson, Ingrid Fiksdahl-King, Shlomo Angel
(Oxford University Press, $27.50)

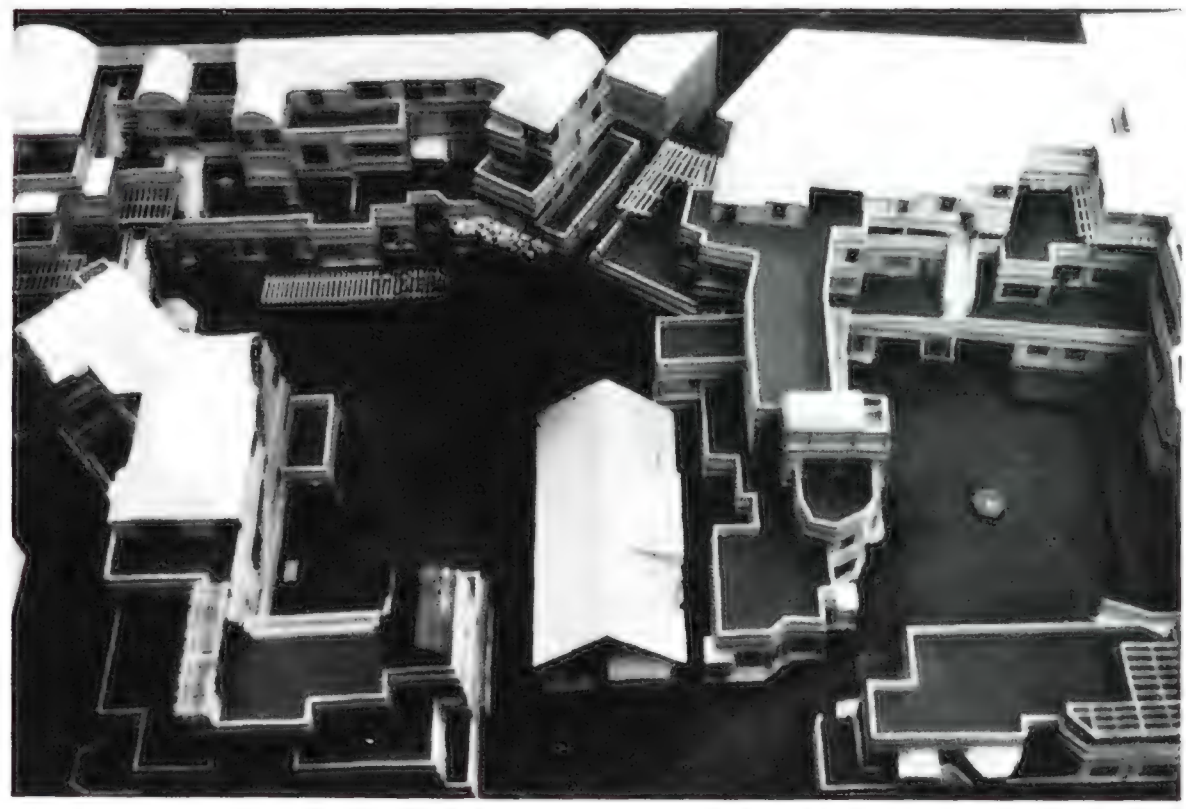
*The Oregon Experiment*
Christopher Alexander, Murray Silverstein, Shlomo Angel, Sara Ishikawa and Denny Abrams
(Oxford University Press, $12.50)

Christopher Alexander would like to see the contemporary professional world of architecture and planning dissolve into oblivion. Alexander, professor of architecture at the University of California, Berkeley, spends a good deal of his time as head of the Center for Environmental Structure in Berkeley. The Center is a nonprofit corporation formed in 1967 to help people design and build their own homes and neighborhoods without the help of architects and planners.

The Center's work up to now has been concerned mostly with academic projects, for which Alexander won the first American Institute of Architects' Medal for Research in 1972. The members of the Center have succeeded in getting a few projects built, including a small, experimental workshop-cottage on the grounds of the Center; some low-cost housing in Lima, Peru, as part of an international competition; and a cluster of workers' houses in Mexicali, Baja California. Currently, Alexander and his associates are working on plans for a new kind of renter-designed apartment house outside Paris, on proposals for migrant-worker housing in Sacramento, California, and a new school in Michigan.

Alexander is proposing an entirely new way of building, based in large part on rules-of-thumb learned over the centuries. It is in direct opposition to supposedly "modern" techniques of design, building and financing. It is rather, Alexander says, "the timeless way of building."

Alexander and the Center are publishing three books which describe this entire new attitude and approach to architecture and planning. The first, Alexander's own, *The Timeless Way of*



Living on the human scale: model for "New Apartment House" in Paris.

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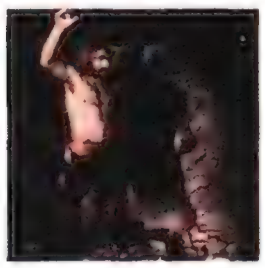

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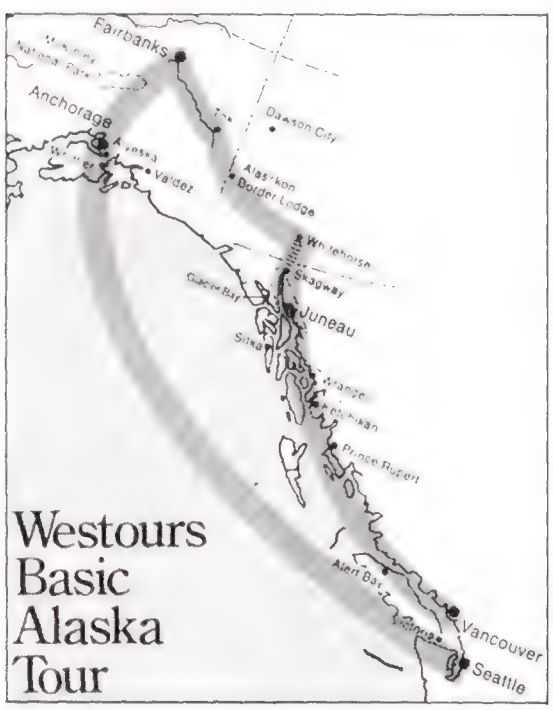


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*–Jim Whittaker for Westours*

JIM WHITTAKER WAS THE FIRST AMERICAN ON MT. EVEREST. He is the leader of the 1978 American Expedition of K2, the world's second highest mountain. Last summer, he and his wife, photographer Dianne Roberts, toured Alaska and cruised the Inside Passage with Westours, Alaska's most experienced guide.

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Near Juneau, we hiked around the Mendenhall Glacier with some folks who had never seen snow before and enjoyed a cool one in the Red Dog Saloon.

Two things we wished we had done, but just ran out of time: Traced the Gold Rush Trail of '98 aboard the narrow-gauge White Pass and Yukon Railroad to Whitehorse; and visited the Arctic Eskimo land.

We visited Anchorage, the Matanuska Valley and Portage Glacier.

I'm convinced now that if you have a limited time to see Alaska, a tour like this one is the way to go. You hit the high spots with absolutely no waste of time.

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*Building*, includes the philosophy; the second, *A Pattern Language*, represents one methodology; and the third, *The Oregon Experiment*, describes an application of the whole process. *The Timeless Way of Building* is forthcoming.

To Alexander, there are buildings which are intrinsically good and buildings which are intrinsically bad, places that are alive and places that are dead. Most of what passes for architecture today is bad building. Most of what was built by common people who unconsciously shared accepted and time-proven ways and styles of building—a pattern language—is good. The architecture of the ancien régime in Europe, the hilltop villages of the Mediterranean and the ancient architecture of the Far East are all examples of the evolution of such a communal work of art.

In *A Pattern Language*, Alexander confronts a situation in which there is no shared language for building today by providing 253 possible general planning principles or *patterns*. Each pattern "states a clear problem that may occur repeatedly in the environment, states the range of contexts in which this problem will occur, and gives the general features required by all buildings or plans which solve this problem."

The patterns range in scale from large regional patterns all the way down to the details of construction. The patterns are not meant to be all-inclusive; particular communities will always need to supplement *A Pattern Language* with patterns of their own.

*The Oregon Experiment*, a new master plan for the University of Oregon at Eugene, is the first published example of an application of the whole process. In this case, the 15,000 students and 3,300 faculty and staff of a university have developed their own pattern language and methods of implementation in order to design their future environment.

New patterns, such as Living Learning Circle, Departments of 400, Student Workplace and Real Learning in Cafes, were integrated into *A Pattern Language*. A new planning board was formed which was geared toward facilitating and guiding community action. Decisions about building were put into the hands of the users. An addition to the music school at the university has already been designed using this new system.

Although some readers might accuse

Alexander of offering philosophy in the guise of factual information, every pattern is based on empirical evidence which is fully documented in both books by numerous diagrams and photographs.

There is also, however, a whole new vocabulary to learn. Phrases like "organic growth," "piecemeal growth," "diagnosis and coordination," have little meaning when related to today's building. When you add this to our dogmatic belief in the sanctity of the professions, I doubt many laymen will come away from these books actually feeling confident enough to design their own dwellings.

Only more examples of self-help design and construction, like those being worked on by the Center, will convince the skeptic that, indeed, people build the best buildings, not architects. For now, the books offer the beginning of a fascinating journey into the heretofore sacrosanct society of the world of architecture, architects and planning.

*—Benjamin Clavan*
Teaching Associate, College of Environmental Design, University of California, Berkeley

*The Ultimate Experiment: Man-Made Evolution*
Nicholas Wade
(Walker and Co., $8.95)

*Biohazard*
Michael Rogers
(Alfred A. Knopf, $8.95)

When molecular biologists discovered they could combine genetic information from two different species to create a completely new form of life, they were both excited at their daring and alarmed at the potential for danger (SMITHSONIAN, June 1977). Their alarm resulted in a self-generated moratorium on recombinant DNA research, and the subsequent 1975 meeting of 150 international scientists and a sprinkling of lawyers and specialists in ethics at the Asilomar Conference Center in Pacific Grove, California. It was at Asilomar that guidelines for DNA research—drafted by the researchers themselves—were first proposed.

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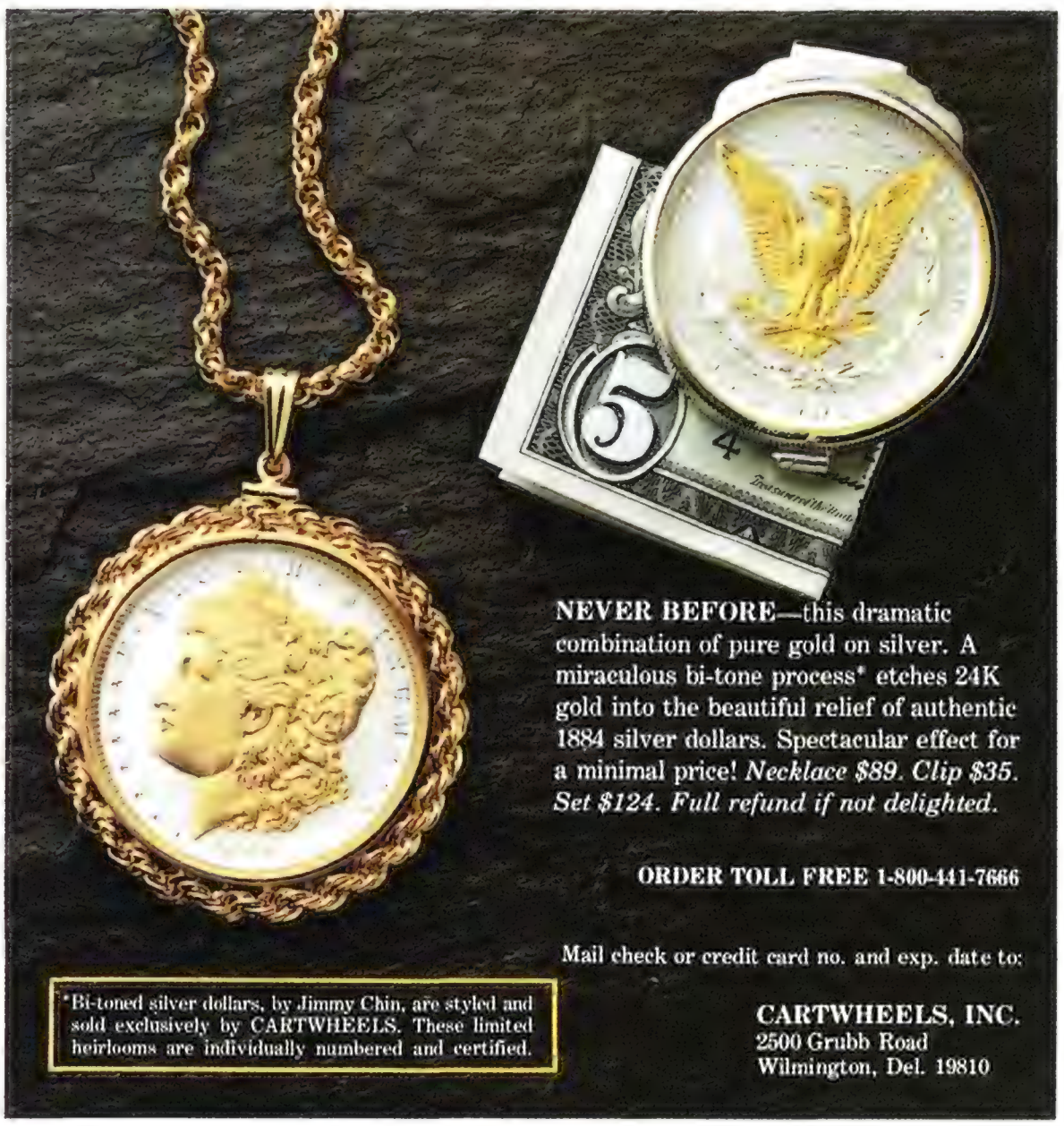


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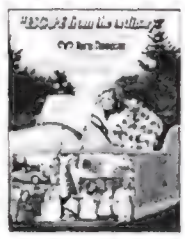

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another species. When this recombined material is inserted in a conducive growing environment—usually a bacterial cell—new genetic information will result in reproduction. In this way, it is possible that a gene product can be harvested.

This is fine if scientists are producing insulin, or a clotting factor for hemophiliacs, or equipping crop plants with their own nitrogen-fixing genes so that the amount of energy used to produce nitrogen fertilizer—the equivalent of two million barrels of oil a day—could be released for other uses.

But what if a cancer virus colonizes in a researcher, thrives there, grows and spreads from person to person? Or if a bacterium containing cellulase, an enzyme that breaks down a structural material called cellulose—which, among other things, gives feces its bulk—got into intestines of humans, it could cause an epidemic of chronic and fatal diarrhea.

These scare-story scenarios are unlikely. But the crux of the recombinant DNA issue is that no one knows the extent of the benefits, or the extent of the risks.

Fears about recombinant DNA are rampant. The public debates in city halls, television features, newspapers, state legislatures and on college campuses and Capitol Hill are confusing and raucous, based on rumors and conflicting data.

Two recently published books will greatly help the public understanding of the issue.

Nicholas Wade, a writer for *Science*, gives a serious recounting of events in *The Ultimate Experiment*.

The initial attempts to discuss the alarming potential of recombinant DNA spread through a network of what Wade's book describes as the East and West Coast scientific elite.

As a result of the Asilomar conference, the National Institutes of Health established guidelines for recombinant DNA work carried out by its own researchers as well as by all the researchers it supports in laboratories across the country. Safety standards were imposed to ensure physical containment within laboratories, and research was limited to biological substances unlikely to survive outside the lab. But having biologists make safety guidelines for containing biological research, critics complained, is much like the tobacco industry making guidelines for antismoking campaigns.

Whether the NIH guidelines were


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too strict or too lax was the subject of the next phase of the DNA debate: should the NIH be the guardian of scientific morality, or should bioethical decisions be made by the local communities in which DNA labs will be built? The biochemists worry that their work will be rejected by the public out of fear and misunderstanding. Maybe it will. But, says Wade, we do not have to accept every technological advance that emerges. "Society can have progress without the SST, agriculture without DDT, even energy without the plutonium cycle. . . . There may be a technological imperative, but society is not powerless to say no."

The historical implications of the DNA issue also attracted the attention of Michael Rogers, author of *Biohazard*. Rogers is not a scientist but, as an associate editor of *Rolling Stone*—in which parts of the book first appeared—he received a science writing award. Rogers played the role of the inquisitive journalist at the Asilomar meeting. He quotes a scientist at Asilomar: "Does anyone in the audience believe that this work . . . can be done with absolutely no hazard?" And then Rogers lets the readers hear the awesome silence that followed.

Rogers gives an overview of the history of biological research, and some of the biohazards that ensued as a result. His book provides the reader with vignettes, chatty information and personal observations about participants in the continuing DNA argument.

But *The Ultimate Experiment* is a more scientific analysis of the issue, and it provides a better base on which to understand the unfolding story of recombinant DNA and other biomedical issues likely to develop over the coming years.
—*Jane Stein*
Free-lance science writer, author of a book on biomedical ethics to be published later this year

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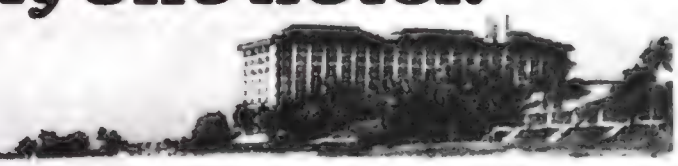

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Bowden concludes that modern cultures built in defiance of nature risk being dehydrated like the ruins of Mesopotamia.

Groundwater makes an ideal subject for this inquiry, for "Moisture buried in the rock, sand, and gravel of the earth demonstrates the common nature of all resources. . . . In this instance, people can believe what is true of all materials: that they have a limited size, that they charge an energy cost for delivery, that different cultures impact different resources at different rates, that in a world where nothing is ever really gone almost anything can move beyond human reach." Thus, there is no way to avoid the consequences if we exhaust this resource. A flowing river may seem to resist depletion, but a finite pool of water does not permit any such complacency.

The "groundwater problem" confronting people who empty the aquifers—60 percent of Arizona's water needs are met by pumping—is one of expense and of ecology. Raising water to the surface consumes energy, increasingly so, as the water level plummets. The pumped water must be purified, but even so its brackish quality can raise the salinity of irrigated fields, poisoning their productivity. Conversely, fields may become waterlogged. Finally, the land resting on an aquifer may subside, leaving fields or cities simultaneously dry and sinking.

Can depleting the treasure of underground water be justified? Bowden cites H. E. Thomas, who believed that "wholesale depletion may be economically feasible in the long-range view if it results in building up an economy that can afford to pay for water from a more expensive source." But Bowden doubts that there are such sources. Can the citizens of Tucson and the farmers of Texas divert water from the Colorado, the Mississippi or the Columbia Rivers? Doing so presumes that billions of dollars of pipes and pumps can be built and powered, that the rains will fall, and that the growing populations and industries of other regions will leave water unclaimed. The rationale for draining, in decades, fossil waters deposited over centuries becomes a matter more of hope than of acceptable economic reasoning.

In face of these physical conditions, "The most interesting facet of the impact of groundwater development in arid lands is variable: human use of groundwater and human response to that use."

Hence the relevance of desert tribes today: "Within the lifetime of humans still alive they have moved from a society perfectly adapted to aridity and absolutely independent of groundwater to a society independent of the desert and based on groundwater. For those interested in peace with nature, the Papago offer abundant clues to the price of such a peace."

Bowden carefully explains the transition of tribal life from foraging to other means of subsistence. The shift from tilling rain-moistened soil to dependence upon river flows increased the variety and quantity of crops available to the Indians, but left them unprotected from dry years and the use of water by new communities established upstream. New uses of energy and resources afforded the desert peoples temporary increases in living standards, but impoverished them when they had lost their ability to adapt to the desert's severe years.

The implication for today is clear. While we enjoy ourselves, rapidly burning fossil fuels and splashing away a unique gift of water, we dissipate natural capital deposited over thousands of years. Already Tucson contains more people than lived in the entire desert a century ago; already the Texas aquifers are emptying. In the decline of the Native American cultures, Bowden perceives a similar threat to modern Americans. After a period of extravagance, we will find our way of life no longer sustainable; nature will enforce a new kind of poverty.

The merit of *Killing the Hidden Waters* lies in its inspection of a single resource, not the world as a whole, and its realistic discussion of alternative means of using it. The author does not glorify the Indians' "hard, impoverished lives." But he does suggest that natural constraints and the experience of past cultures should induce caution. "It is not a revelation," he says, "to learn that cheap energy makes societies boom, that groundwater in arid regions has negligible recharge, that humans tend to use as much of anything as they can lay hands on. We can ignore these facts and pump, mine, and combust with abandon, or we can recognize these facts and attempt to construct a sustainable society. There will be no painless answers, nor were there any in the past."

*—John S. Rosenberg*
Free-lance writer on energy and environmental matters


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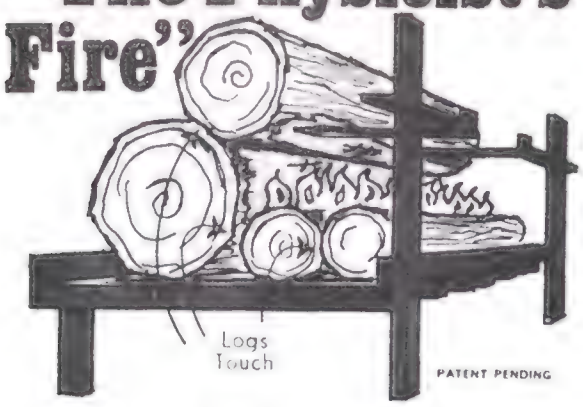


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# *Additional reading*

**Ice ages** (p. 32)

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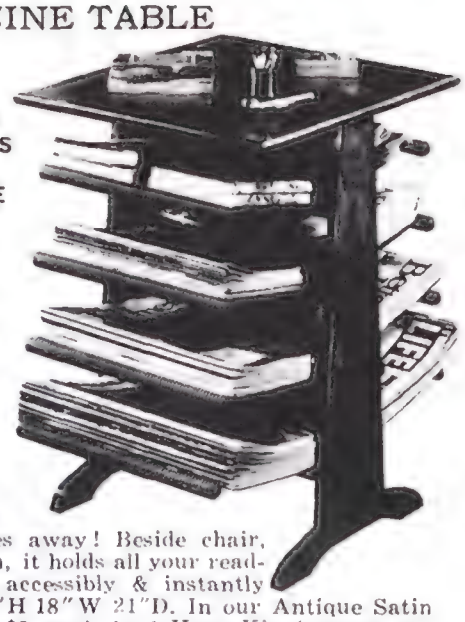

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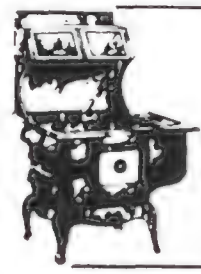

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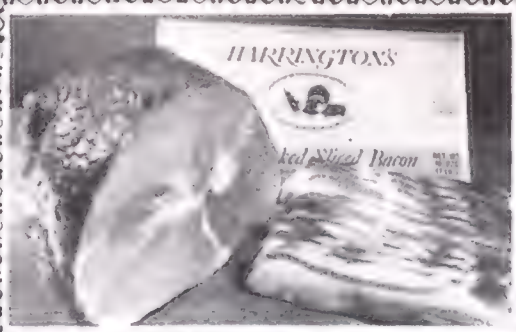


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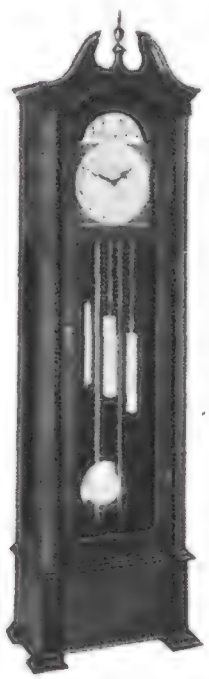

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# *Smithsonian highlights*

## January openings

*Alice Pike Barney and Her Friends*
The National Collection of Fine Arts will open an exhibit of about 50 paintings and pastels by Alice Pike Barney and her contemporaries, on January 20.

*Rehabilitation Discovery Corner*
Newly opened niche at the Museum of History and Technology offers a dramatic view of devices to aid the handicapped.

*George Washington Portrait*
A newly discovered painting of the first President by Gilbert Stuart is now on view at the National Portrait Gallery, an indefinite loan from a private collection.

*Malaspina*
The Museum of History and Technology is exhibiting a collection of American Indian artifacts from the Northwest through February 26.

*Curious Creatures and Mini-monsters*
A nature-loving film by Kjell Sandved starring members of the insect domain will be shown at noon, January 27, in Baird Auditorium.

## Continuing Events

*Division of Performing Arts and Musical Instruments*

- The Theater Chamber Players present an evening of classical music on January 9 at 8:30 P.M. in Baird Auditorium, Museum of Natural History.
- Violin Sonatas by early baroque and classical period composers will be played at 8:30 P.M. in the Hall of Musical Instruments, in the Museum of History and Technology on January 22.
- The Smithsonian Chamber Players will perform in the Hall of Musical Instruments at 8:30 P.M. on January 23.
- Concert Productions—Music by Cole Porter and George Gershwin will be performed in Baird Auditorium at 8 P.M. on January 29.
- Music by Frescobaldi will be performed on harpsichord at 8:30 P.M. in the Hall of Musical Instruments on January 30.

*Lovers in Waves*, by Edvard Munch, appears this month in Little Rock.

*Musical Weekend in May*
Reservations are now being accepted for the Seventh Annual Musical Weekend in Washington, scheduled for May 12-14. For information write: Musical Weekend, Room 4123, Museum of History and Technology, Washington, D.C. 20560.

### Smithsonian Institution Traveling Exhibition Service

SITES has been organizing and distributing exhibitions in the fields of art, science and history for 25 years. For information about a show that fits your organization's needs, write: Eileen Harakal, Smithsonian Institution, Washington, D.C. 20560, or call (202) 381-6631.

- Montgomery, Alabama — "Antwerp Drawings and Prints from the 16th and 17th Centuries" can be seen at the Montgomery Museum of Fine Arts from January 7 through February 12.
- Little Rock, Arkansas — "Edvard Munch: The Major Graphics" presents 51 prints, including four self-portraits, at the Arkansas Arts Center from January 6 through February 4 (opposite).
- Bridgeport, Connecticut—"Hungarian Art Nouveau" presents the Hungarian rendition of the dominant artistic trend in visual arts during the decade preceding World War I. About 135 objects will be exhibited at Sacred Heart University from January 14 through February 19.
- Lockport, New York—"American Coverlets" will be exhibited at the Kenan Center beginning January 21.
- Athens, Ohio—"Bridges, Tunnels and Hydraulic Works" is the topic of an exhibit scheduled to open at Ohio University on January 14.
- West Liberty, West Virginia—"Canyon Graphics and Graffiti" presents the doodles and inscriptions of early man found on this nation's canyon walls. This show opens on January 28 at West Liberty State College.

### Regional Program in Hawaii

In honor of the 200th anniversary of Captain James Cook's rediscovery of Hawaii, the Smithsonian National Associates Program is cosponsoring (with state and local organizations) a series of exhibitions, lectures and performances in Honolulu from January 25 through February 5:

- An exhibition of Polynesian crafts, tools and ceremonial objects with con-


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## Foreign Charter Tours

Mayan Mexico: The Yucatán Peninsula—November 10-22 or December 2-14, 1978: A complete tour of the extraordinary Mayan ruins of the Yucatán. (Originates in Mérida.)

Guatemala—November 1-11 or November 22-December 2, 1978: In the company of an archaeologist, visit Tikal, the monumental Mayan city of the Petén jungle; Copán, a Mayan site deep in Honduras; plus the Mayan ruins of Quiriguá, El Baúl and La Democracia. (Originates in Guatemala City.)

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Paris and Provence*—May 15-29: Paris plus Avignon, Arles, Nîmes and Aix-en-Provence; museum seminars at the Louvre and the new Pompidou center.

Scotland*—September 25-October 9: Edinburgh and beyond—a program of walking tours and special visits in Edinburgh; visits to castles, abbeys, battlefields and archaeological sites, plus incomparable scenic beauties of rugged mountain glens and rolling hillsides throughout the Highlands and Lowlands of Scotland.

The Caucasus: Armenia, Azerbaijan and Georgia*—October 9-23: The spectacular mountain scenery of Transcaucasia; the ancient cities of Erevan, Tbilisi and Baku; medieval churches and mosques; the Caspian Sea and mountain fortresses.

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## Domestic Study Tours

Colonial Crafts—January 18-22: Learn about 18th-century crafts such as graphic arts, woodworking and textiles, through an in-depth program of special lectures, films and demonstrations by Williamsburg's skilled craftsmen.

Victorian Washington—January 27-29: A fascinating program of lectures and neighborhood walking tours to learn about the city's 19th-century history.

Yellowstone in Snow—February 24-March 5: Explore Jackson, Wyoming, in the shadows of the magnificent Tetons; discover Yellowstone in the peace of its winter season, learn about the wildlife of the park and the surrounding region.

Virgin Islands Adventure—March 31-April 9: Explore the British and U.S. Virgin Islands by chartered sailboat to learn about the spectacular natural history in these warm, tropic waters.

New York City—April 14-17: A repeat of the sell-out weekend in November.

Big Bend National Park—April 29-May 6: A nature tour of this Chihuahuan Desert wilderness park in southwest Texas.

Chicago—May 10-14: Discover the architectural treasures of this vibrant city with tours and lectures.

The Magnificent Tetons—June 1-11: In cooperation with the Teton Science School, explore the beautiful backcountry of the National Park.

Shenandoahs—June 3-10: A study of this beautiful area and its geology, archaeology and social history.

Weekend at the Hirshhorn Museum and Sculpture Garden—June 2-4.

Arts and Crafts of the Southwest—June 23-July 1: Learn of the Indian and Spanish influences and the modern arts and crafts of New Mexico.

Washington "Anytime" Weekend—Visit the nation's capital and tour the original Smithsonian building.

For information write Smithsonian Associates Travel Program, A&I 1278, Smithsonian Institution, Washington, D.C. 20560 or call (202) 381-5635.

## Foreign Study Tours

Egypt and Petra via Red Sea—January 30-February 9, 1978: Plane via London to Cairo, board MTS *Argonaut* at Suez for Red Sea, visiting Luxor from nearby port before cruising on to Jordan for Petra.

Himalayan Cultures—March 4-27, 1978: Delhi, Agra, Calcutta, Darjeeling, Nepal, including tigers and Everest viewing, and Bhutan for a five-day exploration.

Gods and Gardens in the Western Mediterranean—April 29-May 15, 1978: Cruise on MTS *Argonaut* from Rome to Lisbon, visiting Roman and medieval centers of civilization in northern Italy and France, Barcelona's museums and architecture, Moorish Spain and Tangier. The guest lecturer will be A. Hyatt Mayor, Curator Emeritus, Print Department, Metropolitan Museum of Art.

Thomas Jefferson in England and France—July 9-30, 1978: His travels retraced, with emphasis on country houses and gardens he admired; led by Professor Frederick Nichols of Charlottesville.

Aegean Sites of Civilization—October 7-29, 1978: A cruise on MTS *Argonaut* with Dr. Richard H. Howland, including Thrace, Istanbul, Troy, Ionia, Mt. Athos, Mistra, Thera, Crete and principal classical sanctuaries, leaving from and returning to Athens. *Optional prelude may be the following:*

Nostalgic Orient Express—October 2-8, 1978: Vintage cars restored to superb condition, over original Simplon routing from Zurich to Athens.

For detailed information write Miss Bliss Schumann, Foreign Study Tours, S.I. 123, Smithsonian Institution, Washington, D.C. 20560 or call (202) 381-5520.

ducted tours by Dr. Herman Viola, director of the Smithsonian's National Anthropological Archives.

- Paul Desautels, curator of the Smithsonian's gem collection, will discuss an exhibition of jade objects from the world's major jade-carving centers.
- Charles Millard, chief curator, Hirshhorn Museum will lecture on the sculpture of Edgar Degas.
- Lee Houchins, a research fellow at the National Museum of History and Technology, will lecture on Hawaii's strategic place in America's maritime trade history.
- Marc Pachter, historian at the National Portrait Gallery, will present a slide show on the impressions of 19th- and early 20th-century Eastern visitors to the United States.
- Richard Fiske, of the National Museum of Natural History, will lecture on the development of systematic volcano watching in Hawaii.
- The Smithsonian Chamber Players will perform baroque and classical music on antique instruments.

For further information write: Smithsonian National Associates Program, A&I Building, Room 1208, Smithsonian Institution, Washington, D.C. 20560 or call (202) 381-6491.

**Associates reception in Washington**

From 10 A.M. until 4 P.M. daily, Associates are greeted in the original Smithsonian Institution Building—the old red castle on the Mall. Here members are invited to register, receive special orientation materials and relax in the Associates Lounge. Misplaced membership cards are replaced upon presentation of a SMITHSONIAN magazine address label.

Associates may send a postcard or phone for an information packet: Associates Reception Center, Smithsonian Institution, Washington, D.C. 20560 or phone (202) 381-6264.

*Members Dining Room*

The Court, the Associates dining facility, is located in the Museum of Natural History. A buffet luncheon is served seven days a week from 11 A.M. to 3 P.M., priced at $3.95 for adults and $2.95 for children. A hearty breakfast is served weekends only, 8:30 to 10 A.M., priced at $2.95 for adults and $1.95 for children. For breakfast, enter via Constitution Avenue.


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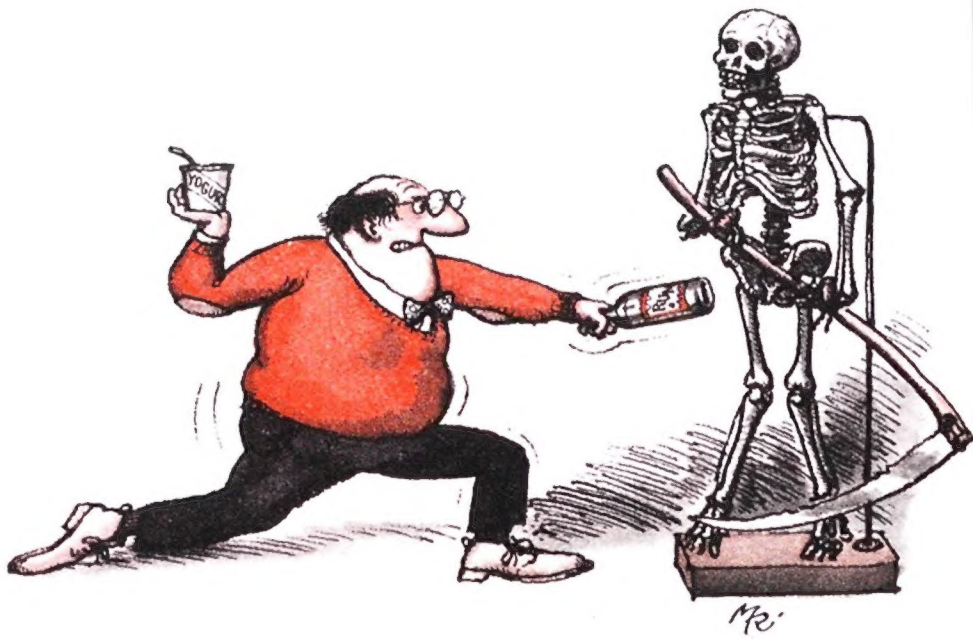
*By Patrick Ryan*

# *Some prefer old age to the alternative*




The professionally premature death was lately reported of Dr. Eric St. John Lyburn, a British physician who invented a machine to prolong human life by 20 years. He unfortunately departed this world at 72 years of age, a bare two years beyond the Biblically allotted span. This 18-year shortfall might be interpreted by the superstitious as a divine reminder of the futility of human efforts to forestall inevitable fate.

Lyburn's device consisted basically of a heat steam bath and a refrigeration unit, operating so that the occupant's body was heated to 112 degrees F, while his head was cooled to between 4 and 14 degrees below freezing. Lily-livered hedonists might voice doubts as to whether any earthly prolongation so achieved really could be worth it, if the price involved regular periods of living with your brain in the Arctic and your belly in the tropics —or with your toes being gently parboiled while icicles crackle delicately in your back hair.

Aspirations to immortality have long plagued *Homo sapiens.* Adam may have set the first long-lived target for his more ephemeral descendants when, despite the difficulties of his early married life and all that trouble between the first two boys, he managed to live to the scriptural age of 930 years.

During the fourth century A.D., Ko Hung, an alchemist, proclaimed, after exhaustive research, that a mixture of liquid gold and pure cinnabar, nine times transmuted, produced the one true elixir of immortality. He further recorded his regret that he was personally too poor to afford the necessary expensive ingredients to extend his time. Other life-lengthening nostrums prescribed down the years include royal jelly, gland grafts, bizarre injections, yogurt consumption and other dietary eccentricities.

All have served to prolong the hopes of the users rather than their years, and the Biblical estimate of 70 to 80 years still accurately characterizes the human lifespan. Somerset Maugham, as late as the recent 1960s, used to go to Switzerland every now and again in expectation of staving off the reaper by being injected with goat hormones. However medical opinion may view this Capricornic treatment, it certainly enabled the novelist to do better than the late Dr. Lyburn, since he managed to live into his 91st year.

Modern longevity researchers have been examining the unusual incidence of alleged centenarians in the valley of Vilcabamba in Ecuador. "One particularly remarkable feature," it has been noted, "was that the inhabitants drink two to four cups of rum a day." An elixir of life, mark you, which sounds much tastier than liquid gold and cinnabar. And, anyway, even if you don't actually make immortality on it, at least you're going to be a bit happier along the way. I suggested to my wife that, to ensure her enjoyment of my terrestrial company for as long as possible, I should adopt the Vilcabamban prescription. She replied that there was no point in doing so because my current spirituous intake obviously had already assured me of physical immortality.

Seeds of trepidation were sown by Jonathan Swift in *Gulliver's Travels* when he introduced his leading man to the Struldbrugs, those remarkable people born with a circular spot over the left eyebrow which signified that they would never die. Though thus miraculously equipped with immortality, the Struldbrugs—Swift being Swift—were not provided with any immunity against the normal progress of aging. And so they lived on and on and on, without hair, teeth, strength, taste or memory, multiplying their senescent infirmities with the passage of the unending years.

While the verifiable human champion, a resident of Herkimer County, New York, lived into her 114th year, our nearest rival in endurance is the Indian elephant which follows, way back down the field, with an official record of 77 years. Yet still, as Susan Ertz observed, "Millions long for immortality who do not know what to do with themselves on a rainy Sunday afternoon." And the source of such seemingly irrational ambition may lie in Maurice Chevalier's reply, when asked his reaction to advancing years: "I prefer old age to the alternative."

Some helpful guidance to those intent on deferring their due appointment with time may be found in the gospel according to *Catch 22.* Not in the negative teaching of Dunbar, who aimed to extend the number of his days by cultivating boredom—to such perverse effect that once, when lying motionless on his bed and staring at the ceiling, he worked "so hard at increasing his life span that Yossarian thought he was dead." Wiser, and less vulnerable to disappointment, would it be to adopt the humbler and less arduous philosophy of the noble Yossarian himself, who simply "decided to live forever or die in the attempt."

Energy for a strong America

# DR. TERRI PECORARO: She's helping Exxon squeeze more energy out of a barrel of oil.

To put it simply, after crude oil is refined into gasoline and other products, a tarlike residue remains which is usually made into products like asphalt.

Dr. Terri Pecoraro, an Exxon chemist in the highly technical area of catalysis, is part of a team of scientists working to squeeze more usable energy out of that residue.

As Terri explains it, the right catalysts can help convert the residue into gasoline and heating oil. They can also help remove sulfur and nitrogen to produce cleaner-burning fuels that reduce air pollution—a major goal of Exxon research for years.

And as a long-range bonus, catalysts that remove sulfur and nitrogen may someday help produce liquid fuels from coal, which is America's richest storehouse of energy.

"There's more to being a chemist than just doing your science," says Terri. "Many things that look scientifically feasible may not be practical. It's sitting down with the chemical engineers and materials scientists to see if an idea is practical that makes my work intriguing and fun."

Off the job, Terri enjoys cycling, playing tennis, and swimming along the Jersey Shore with her husband, who is also an Exxon chemist.

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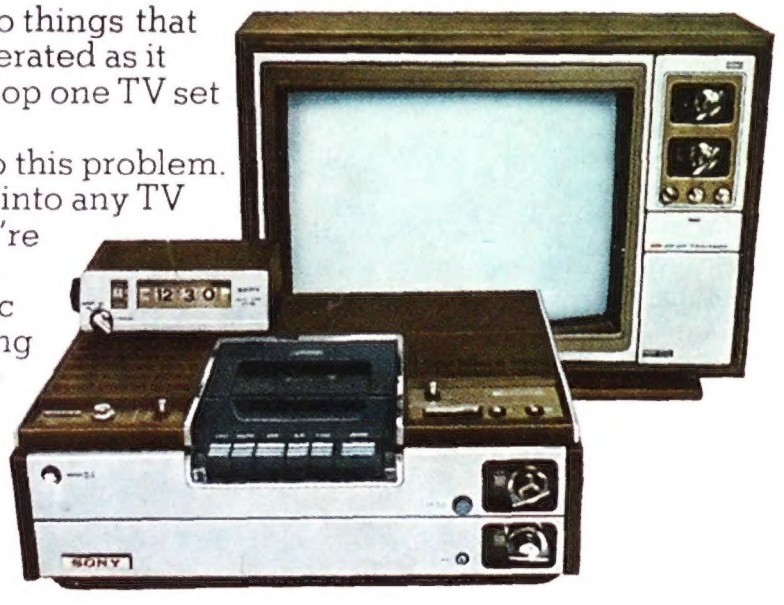

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